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Alaska Coastal Zone Management Program

FINAL REPORT
VOLUME I
ANCHORAGE COASTAL STUDY
INTEGRATED TERRAIN UNIT MAPPING, AUTOMATION AND ANALYSIS

ESRI
380 New York Street
Redlands, California 92373

FINAL REPORT
VOLUME I
ANCHORAGE COASTAL STUDY
INTEGRATED TERRAIN UNIT MAPPING,
AUTOMATION AND ANALYSIS

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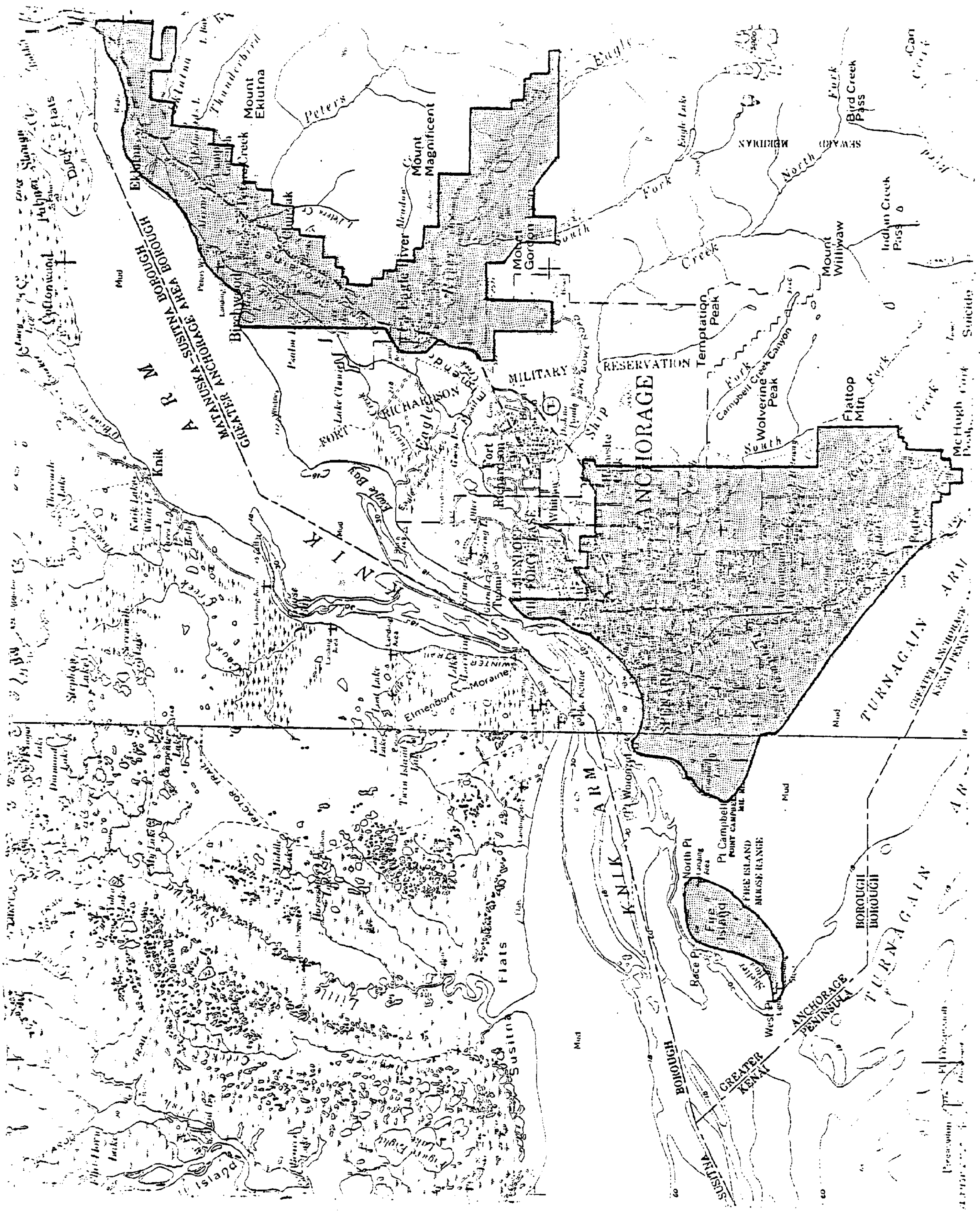
INTRODUCTION

Environmental Systems Research Institute (ESRI) was contracted to provide technical and consulting services to the Planning Department of the Municipality of Anchorage in relation to the identification and evaluation of environmental opportunities and constraints in the Anchorage coastal zone. As a major component of this effort, ESRI developed an Automated Geographic Information System (GIS) and conducted a systematic land capability/suitability analysis for two study areas within the coastal zone. The first of these study areas, termed Eagle River, is located north of the urban core of Anchorage and encompasses an area of approximately 20,785 hectares. The second, termed Anchorage Bowl, is centered on the City of Anchorage. Including Fire Island to the west, it encompasses an area of some 38,475 hectares. The two study areas are not contiguous. As evident in Figure 1, Elmendorf Air Force Base and Fort Richardson Military Reservation lie between them.

The ESRI effort was conducted as part of a broad coastal zone planning and management effort. It was funded in part through a Coastal Zone Management Program (CZMP) grant and a Coastal Energy Impact Program (CEIP) grant from the US Department of Commerce and the Division of Community Planning, Department of Community and Regional Affairs of the State of Alaska. The effort was carried out under a contract with the Department of Planning of the Municipality of Anchorage. Anthony Burns, Senior Planner, directed and administered the contracted effort. Aerial imagery, topographic maps, and collateral data used in the effort were collected largely through the efforts of the staff of the Department of Planning.

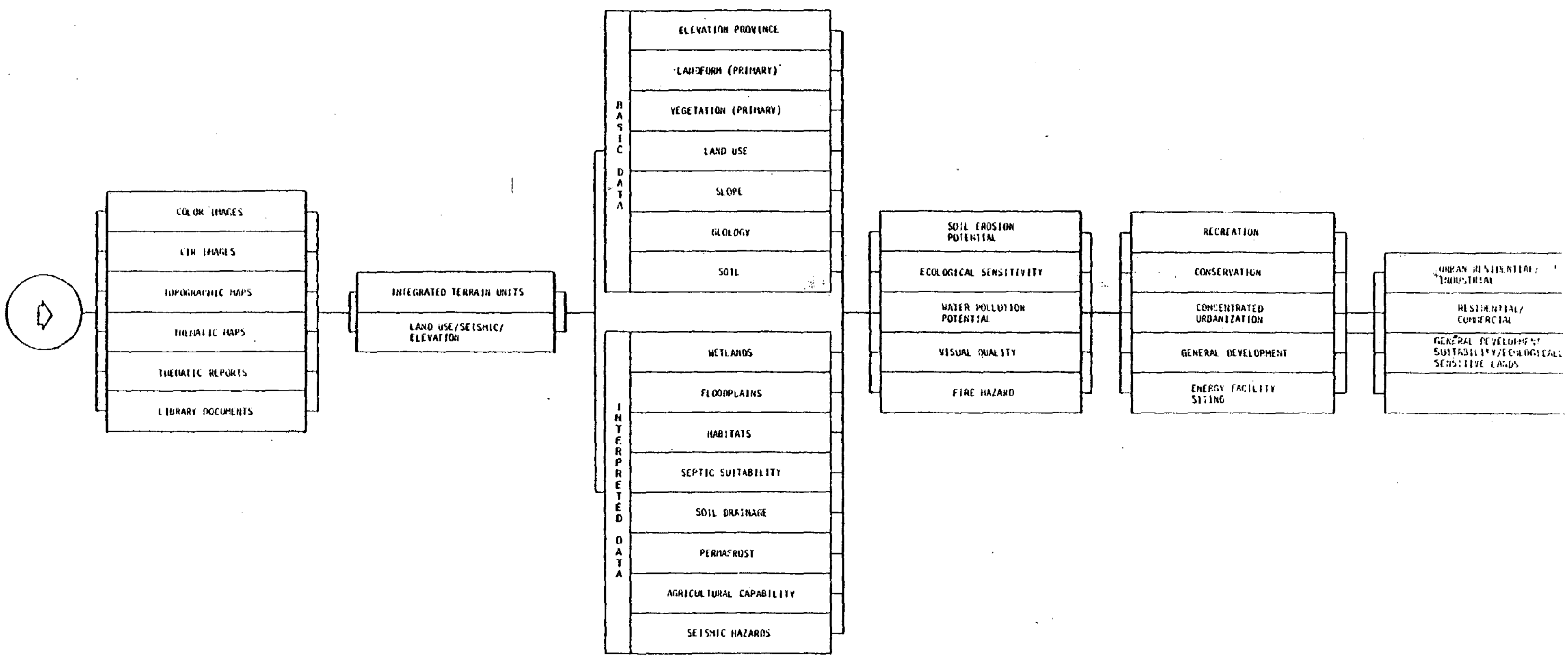
STUDY AREA MAP



The automated data system developed for the Eagle River and Anchorage Bowl study areas was designed to satisfy a broad range of land planning and management interests. It is comprised of a large number of interrelated, land-based data types which were selected to serve both long, and short term interests. As part of the overall effort the automated data base was applied in relation to the following: the assessment of general environmental opportunities and constraints; the evaluation of specific land capabilities and suitabilities; and the identification of existing and potential land use conflicts. Figure 2 illustrates the general components of the GIS and the sequential application of the GIS in the process of environmental impact analysis and evaluation. One specific application of the system involved the evaluation of land capability/suitability in the coastal areas for energy facility siting. This evaluation, like the one dealing with general development potential, was directed by a conceptual model which underwent several iterations before being finalized. Given the permanent nature of the GIS, new and modified criteria for a given model or entirely new models addressing more specific land uses can be quickly and inexpensively implemented.

In many respects, the creation of the automated GIS for the Eagle River and Anchorage Bowl study areas represents the culmination of a resource inventory and analysis effort which commenced several years ago and which, among other things, involved the detailed mapping and field survey of geologic and soil resources in both of the areas. Many of these studies were focused on the definition and mapping of geologic hazards including the following: slope stability/ mass wasting; seismically

Figure 2
Environmental Analysis Flow Chart



induced ground failure; and earthquake intensity.

As part of the present study, two discrete photo-interpretation efforts were conducted, one involving the interpretation and delineation of landforms, the other of vegetation. These and other data were subsequently rectified, cross-compared, and composited by ESRI in the pre-automation process. Related natural phenomena such as geology, landform, slope, soils, and vegetation were cross-compared and composited in a single map overlay by a process termed, "Integrated Terrain Unit Mapping". This process imparted a higher level of spatial resolution, accuracy, and consistency to the mapped data than was otherwise inherent in the diverse source materials. The terrain unit map was composed of individual units, each of which encompassed a set of homogeneous characteristics. The numerous data planes represented on the map were segregated and mapped as independent phenomena after the process of automation was completed. In order to accomodate several data sets which did not fit with the essential elements of the terrain unit, a second composite map overlay was created. It is important to note that the pre-automation compositing and integration process provided for a high level of technical and cost efficiency in the subsequent data automation effort.

The development and application of the data base for Eagle River and Anchorge Bowl represents one aspect of the development of a GIS technology within the Municipality of Anchorage. This study provided an opportunity for professional and technical personnel from the Municipality to participate in all phases of data base design, implementation, and application. It also resulted in the creation of a data base which has been structured for installation on a computer facility in the Municipality. It is conceived that this data base, the first of many, will serve as a component of a superstructure for the efficient storage and retrieval of environmental data for the Municipality and as the context for its legible and systematic application to future land planning and management functions.

As indicated, landforms and vegetation cover in the two study areas were mapped as part of this study. Landform interpretation and mapping was conducted by Ray Kreig Associates. Landforms and vegetation types were identified and delineated using 1:12,000 scale natural color aerial photos (1978) and 1:63,360 scale color infrared aerial photos (1978). The latter photos were enlarged to black and white cronaflex transparencies at a nominal scale of 1:25,000 in order to facilitate the mapping process. The diverse collateral data provided to ESRI at scales ranging from 1:15,000 to 1:250,000 were re-scaled to a consistent 1:25,000 scale, checked against aerial imagery, and rectified to a standard planimetric base as part of the process of GIS development. The first step in the development of the GIS was the creation of a set of stable mylar basemaps of the region. These basemaps were created at a scale of 1:25,000. All data variables were scaled and rectified to the basemap series. Eighteen general types of data were mapped for automation. All data were mapped in a polygon form. This provided optimal representation of the configuration of these natural phenomena. Terrain unit polygons had a minimum resolution of four hectares, areal units smaller in size generally not being captured as discrete units. Related data variables were composited on the same map sheet as re-scaled boundaries were being rectified and redrawn. Two manually drafted mylar sheets termed, "Map Manuscripts", were drawn for each of the ten map modules comprising the two areas. These manuscripts and the data types which they encompass are outlined below.

Manuscript No. 1
Integrated Terrain Unit Map

Basic Environmental Data
- Landforms
- Vegetation
- Surficial Geology
- Slope Gradient
- Surface Form
- Soil

Pre-Interpreted Geo-Environmental Data
- Slope Stability
- Mass Wasting
- Seismically Induced Ground Failure
- Floodplain/Coastal, Flooding/Erosion
- Foundation Conditions
- Groundwater
- Permafrost
- Wetlands
- Habitats

Manuscript No. 2
Land Use/Elevation/Seismic Map

Basic Environmental Data
- Elevation Province
- Land Use

Pre-Interpreted Geo-Environmental Data
- Earthquake Intensity

The mapped data were automated by a process of x,y coordinate digitizing. The automation procedures provided for the accurate capture of the natural form of the mapped data. The computerized data files, composed of polygons, were used to create a number of plotter drawn maps of the study areas, as well as to create a parallel set of data files in a grid format. A uniform grid was laid atop each of the original data files in the computer, and the data values were transferred into and recorded by individual grid cell. This grid cell data bank, ultimately formatted as a grid multi-variable file, was used to produce a grid map atlas of the region and to display the mapped results of the environmental analyses which were conducted. It is important to note that once map data existed in a computerized form, they could be accurately displayed at a variety of different scales. However, the final products of the study were produced at a scale of 1:25,000. The following computer maps, which illustrate some of the basic data and interpretations coded into the GIS, were produced:

Basic and Interpretive Data Maps
(1:25,000 Scale)

	Anchorage Bowl	Eagle River
Polygon Plotter Maps		
Basic Data		
Landform	X	X
Vegetation	X	X
Slope	X	X
ITUM Polygon Number	X	X
Grid Electrostatic Maps		
Basic Data		
Elevation Province	X	X
Landform (Primary)	X	X
Vegetation (Primary)	X	X
Land Use	X	X
Slope	X	X
Geology	X	X
Soil	X	X
Interpreted Data		
Wetlands	X	X
Floodplains	X	X

Habitats	X	X
Septic Suitability	X	X
Soil Drainage	X	X
Permafrost	X	X
Agricultural Capability	X	X
Seismic Hazards	X	X

The computerized data bank was subsequently used to evaluate and assess environmental conditions in the two study areas in relation to certain potential uses. A series of theoretical models were constructed to assess natural opportunities and constraints in the region, to evaluate the capability and suitability of land for select uses, and to identify actual and potential land use conflicts. ESRI staff worked with representatives from the Municipality in structuring the overall format for the analyses and in outlining the format and variables for each of the models. Thirteen conceptual models, comprised of selected, prioritized and ranked factors, were programmed by ESRI staff. Their application to the computerized and gridded data resulted in the sequential overlay of each of the select variables and the automatic calculation of mathematical values for each of the same 230,000 grid cells comprising the two study areas. In general, each of the models underwent several iterations before being finalized. The map output from each model was evaluated by Municipality staff. Where appropriate, the models were modified. It is important to note that the data base which was developed in the course of the effort has been designed for installation on a computer facility in Anchorage and that it is anticipated that in the future, additional modeling and mapping applications can be made locally. The following computer maps illustrate the results of the models which were developed. These maps were produced in an electrostatic gray-tone format at a scale of 1:25,000.

Model Maps
(1:25,000 Scale)

	Anchorage Bowl	Eagle River
Electrostatic Grid Maps		
Opportunity/Constraint Analyses		
Soil Erosion Potential	X	X
Ecological Sensitivity	X	X
Water Pollution Potential	X	X
Visual Quality	N/A	X
Fire Hazard	X	X
Capability/Suitability Analyses		
Recreation	X	X
Conservation	X	X
Concentrated Urbanization	X	X
General Development	X	X
Energy Facility Siting	X	N/A
Conflict Analyses		
Urban Residential/Industrial	X	X
Residential/Commercial	X	X
General Devlopment Suitability/ Ecologically Sensitive Lands	X	X

This report is designed to provide an overview of the methodology and results of the study. It is accompanied by a series of appendices which enumerate and document the data types, data sources, mapping methodology, and final computer data files. Collectively, the report and the computer maps document, illustrate, and provide statistics for the significant environmental impact concerns in the study areas. The report is divided into five chapters, one dealing with each major phase of the effort. Three Appendices, formatted in a separate volume, are used to supplement and complement the basic volume.

The first chapter, entitled, "Data Collection and Classification", describes the general procedures employed to collect the data and structure a conceptual framework for interpretation, mapping, automation, and to analysis. The essential focus of the chapter is an outline of the form in which related data variables are composited on the same map and the general way in which data are classified. The classification scheme is of essential importance with respect to all potential applications of the system. It sets both the upper and lower limits of the potential applications of the system. The second chapter entitled, "Data Mapping", describes the general sources for the interpretation and mapping of data as well as the processes used to composite and, in some cases, integrate data onto map manuscripts for automation. The third chapter, entitled, "Data Automation", deals with the processes used to accurately translate the spatial configuration and numeric codes of mapped data into a machine readable form. In addition, it includes outlines and descriptions of data interpretations and deriviations which were made an integral part of the data bank and which, in effect, supplement and complement the data types and classes outlined in Chapter I. The fourth chapter, entitled, "Computer Modeling", deals with the theoretical models which were developed to assess natural opportunities and constraints, to evaluate land capability and suitability, and assess existing and potential land use conflicts in the two study areas. An outline is provided for each of the models. The fifth chapter, entitled, "Computer Mapping", provides an outline and description of all of the computer maps which were developed for the study area. It is focused on a series of legend sheets which identify the data displayed on each of the maps comprising the ESRI atlas of the region. It stands somewhat in parallel with Chapter I, the former outlining the essential components of the incipient data bank, the latter the visible record of it

Chapter I

Data Collection and Classification

I. DATA COLLECTION AND CLASSIFICATION

A. Introduction

At the outset of this study, the specific data necessary for the desired analyses were determined. The collection of data was structured by this determination. The first step in the process required a decision as to the general types of data needed. The analyses to be performed for the many aspects of the Anchorage Coastal Study required information on such diverse environmental considerations as geology, landform, soils, vegetation, geologic hazards, wetlands and habitats, and land use. The data base was to also include the results of numerous engineering and resource studies performed in the Anchorage area, such as Geotechnical Hazards Assessment maps and those for the District Coastal Management Program. Data were collected for all of these general considerations. These data were in two forms: collateral data - previously mapped or delineated information which, with necessary rescaling and spatial rectification and adjustment, was utilized directly for mapping; and interpreted data - photo-interpreted from a variety of sources by the study team. The third major step in the data collection process was the development of a data classification system which would provide for consistent interpretations and designations for the data. This system subdivided the general types of data into specific variables and in turn classified the information into specific levels or categories. Finally, a set of basemaps were created which were used for the rectification and mapping of all of the requisite data.

B. Methodology

The initial determination of data needs guided the data collection effort. Most of the data used in the study were obtained by ESRI from the Department of Planning of the Municipality of Anchorage. Some data were obtained in the course of previous studies conducted by ESRI in the Anchorage region. Field surveys undertaken as part of these previous studies enabled the ESRI study team to become familiar with the general environment of the area, and to accurately identify and describe the representative patterns or signatures on the aerial imagery. A listing of the materials used in the interpretation and mapping effort is provided in the bibliography at the end of this report.

Once these materials were obtained, inventoried, and reviewed, necessary revisions were made to the original categorization of the data in order to most efficiently capture the data. Two "manuscript" (preliminary hand-drawn) maps were outlined for compositing and delineating the assembled data. A detailed classification scheme was then developed, described in the following section of this chapter. Explanations and descriptions of the collateral and interpreted information used to map each of the data variables are presented in Appendix B of this report.

Following the initial phase of data collection, a set of consistently scaled basemaps of the sub-basin were formatted on translucent mylar. Ten USGS 7.5-minute topographic quadrangle maps at scales of 1:25,000 were reproduced to provide a set of detailed and consistently scaled basemaps on mylar for the study area. Ten topographic maps were used to provide coverage for Eagle River and Anchorage Bowl. These include a separate mosaiced base map was prepared for Fire Island. As indicated below, it was composed of portions of three separate map sheets.

Eagle River

Anchorage, B7 NW
Anchorage, B7 NE
Anchorage, B7 SW
Anchorage, B7 SE

Anchorage Bowl

Anchorage, A8 NW
Anchorage, A8 NE
Anchorage, A8 SW
Anchorage, A8 SE
Tyonek, A1 NE

Fire Island

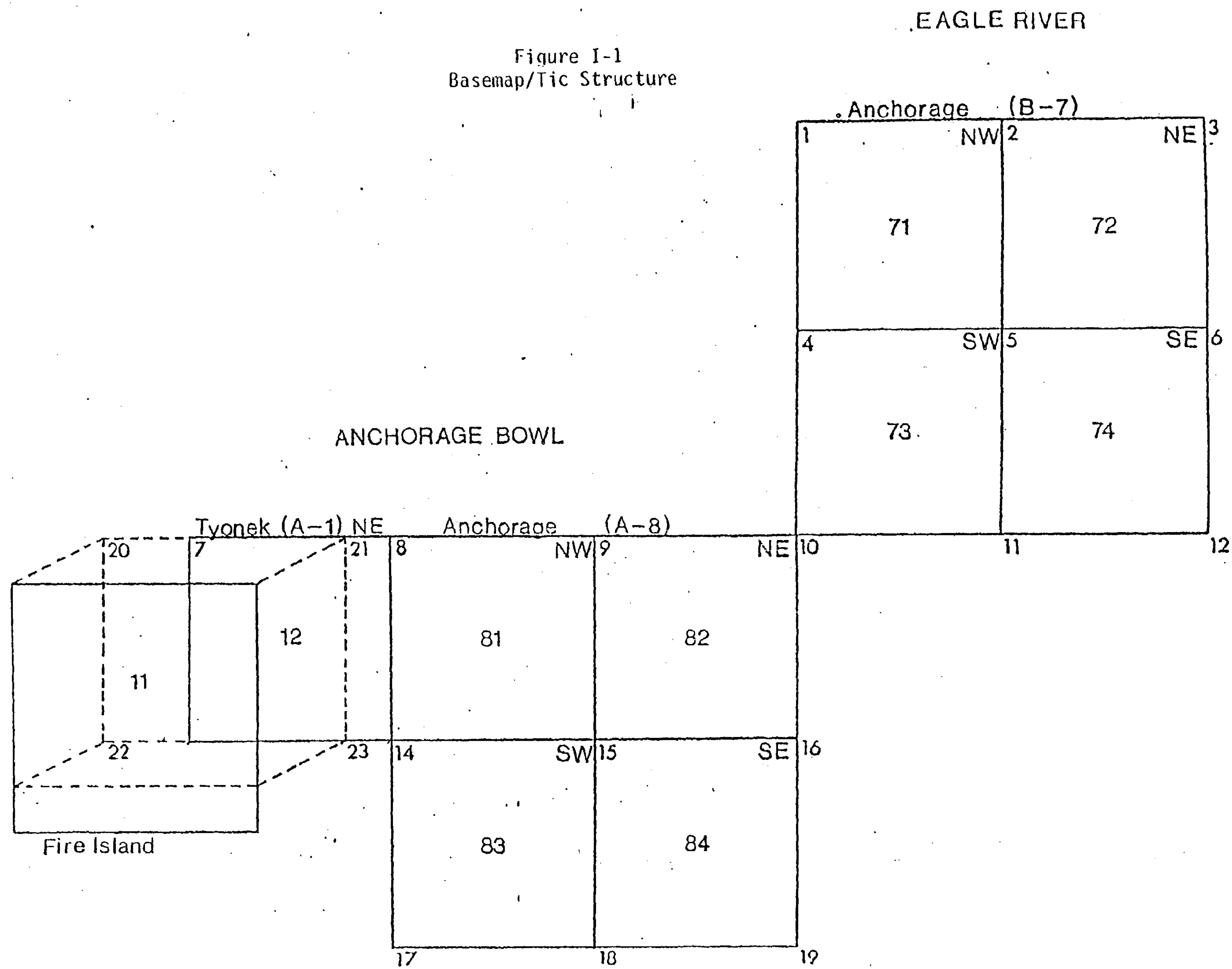
Tyonek, A1 NE
Tyonek, A1 NW
Tyonek, A1 SW

Each of the ten basemaps, or more accurately, that portion of the study area included on the basemaps, was termed a study area "module". In order to ensure accurate and consistent registration, four tic marks were placed on each basemap module. Thereafter, every overlay manuscript which was drafted was registered to these tic marks. The structure of the basemaps created for the Anchorage Bowl and Eagle River areas and the numbering of the tic marks are identified on Figure I-1.

C. Data Structure and Classification

As indicated, the definition of data classes for each of the variables in this study was guided by considerations similar to those which guided the selection of the variable themselves. That is, the data classification had to consider information critical to the required level of environmental evaluation, it had to reproduce the results of the special studies, and it

Figure I-1
Basemap/Tic Structure



had to be broad enough to produce legible maps with sufficient detail to be useful. In general, related data variables were identified for mapping on the same manuscript. The manuscripts were designed as a means of efficiently compositing the broad range of data selected for inclusion in the automated system. It should be noted that the manuscripts were designed for application atop the ten module spatial structure of the GIS; that is, two manuscript maps were identified for overlay atop each of the ten 1:25,000 scale map modules covering the study area.

The following outline illustrates the essential nature of the data structure and classifications employed in the creation of the GIS for the Eagle River/Anchorage Bowl area. A complete enumeration of the classification and codes is provided in Appendix A of this report. Desriptions of each mapped class are provided in Appendix B.

DATA STRUCTURE
COASTAL STUDY

MANUSCRIPT #1
INTEGRATED TERRAIN UNIT MAP

Data Type	Number of Classes
LANDFORMS	
Landform Combinations	7
Landform Connectors/Modifiers	5
Landform Types	126
VEGETATION	
Vegetation Types/Combinations	132
SURFICIAL GEOLOGY	
Surficial Geology Type	18
SLOPE	
Average Slope Gradient	8
SURFACE FORM	
Surface Form Type	4

SOILS	
Soil Type	39
Soil Survey	2
SLOPE STABILITY	
Slope Stability Rating	5
MASS WASTING	
Mass Wasting Rating	7
SEISMICALLY INDUCED GROUND FAILURE	
Ground Failure Rating	6
FLOODPLAIN/COASTAL FLOODING/EROSION	
Flooding Rating	8
Erosion Rating	5
FOUNDATION CONDITIONS	
Foundation Conditions Rating	6
GROUNDWATER	
Groundwater Rating	3
PERMAFROST	
Permafrost Rating	4
WETLANDS	
Wetlands Type	10
Wetlands Name	143
HABITATS	
Habitat Types	7

MANUSCRIPT #2
LAND USE/SEISMIC/ELEVATION MAP

Data Type	Number of Classes
ELEVATION PROVINCE	
Elevation Zone	4
LAND USE	
Land Use Type	16
EARTHQUAKE INTENSITY	
Intensity Rating	4

Chapter II

Data Mapping

II. DATA MAPPING

A. Introduction

As indicated, the mapping phase of this project involved the delineation of the data collected from the Municipality of Anchorage and that derived through the process of photo-interpretation on two separate manuscript maps. Each of these manuscripts represented a class or format of data that could conveniently and meaningfully be displayed on one map. All of the information was areal, such as landform or geology, and was shown as spatial units called polygons. The manuscripts prepared and the format of the data shown are as follows:

Manuscript No.	Name	Data Format
No. 1	Integrated Terrain Unit Map	Polygons
No. 2	Land Use/Seismic/Elevation Map	Polygons

The integrated terrain unit map utilized a mapping concept which resolved related environmental data to a single manuscript map. Its creation involved the manual overlay and integration of individually interpreted and mapped single-variable overlays onto a single map at a scale of 1:25,000. This scale was sufficient to accurately capture information from the 1:12,000 color imagery and 1:63,360 color infrared imagery as well as the data represented on the collateral overlays. Each overlay contributed lines which were drafted onto the manuscript. However, given that boundaries between natural phenomena were often coincident, the process often involved the delineation of a single line on the manuscript in place of several different but generally consistent lines which existed on individual overlay maps. Very small mapping units on the overlays, those smaller in size than approximately 10 acres, were typically merged into larger surrounding or adjacent units. Thus, the data on this manuscript are considered to have a minimum polygon resolution of 10 acres. The result of the process was the development of integrated terrain unit maps comprised of several thousand polygons, each representing areas of homogeneous natural characteristics. The other manuscripts was created by a process of rectification and compositing. It should be noted that data rectification was accomplished in relationship to the topographic base maps in all instances where they were considered reliable.

B. Methodology

The basic concept underlying the preparation of polygon maps such as Manuscript No. 1 was the Integrated Terrain Unit Mapping (ITUM) approach, used to integrate several kinds of variables into a single polygon map. There are four general principles dealing with the distribution of natural geographic attributes that relate to the ITUM approach.

1. The Principle of Graded Likenesses and Infinite Differences in Natural Areas

No two geographic locations or areas are ever exactly alike, although similarities can be perceived between areas which permit classification of areas into like kinds. The degree of perceived dissimilarity increases directly as the closeness of scrutiny increases. Conversely, similarities become more obvious as observation is less detailed.

2. The Principals of Areal Transitions

Changes in natural geographic characteristics from one area to another are usually gradational. The rate of change along such gradations may vary. Thus, the placement of a line drawn to show the separation of any two features is in part a subjective decision. This means that for two or more data variables, different lines can be resolved into a single line, representing the best fit for both features, which can be drafted onto the final ITUM manuscript.

3. The Principles of Continuous Alteration of Areal Characteristics With Time

All the characteristics of any geographic area are changing continuously, although each feature changes at a rate which differs from the rate of change for other features. Since some features change more rapidly than others, the map has some data dealing with rapidly changing features and other data dealing with feature which change quite slowly under most circumstances.

4. The Principle of the Functional Interrelatedness of Environmental Elements

As the pattern of any environmental attribute changes, it will have recognizable effect on the patterns of other environmental attributes in the same area. This interrelatedness often means that the various features of an area will respond somewhat as a unit, what might be called an "ecological response unit". The rate of environmental changes are determined by those factors described in Principle 3.

The ITUM mapping process resolves some major obstacles to the computerized handling of spatially defined environmental information: the cost of automating multiple parametric data planes; the cost of doing polygon overlays in the computer; the problem of polygon "splinters" created through the overlay process; and perhaps most importantly, the problem of mismatched data sets which are supposed to be related and consistent. In many respects, the latter point represents the ultimate argument for the integration process. When complex land capability/suitability or conflict modeling is done in a data base, such as was done with that for the Eagle River and Anchorage Bowl, the mismatches among the data planes can cause major errors to surface across the mapped output. Differentiating between the valid and invalid values which are thus registered is difficult and often impossible. Using computer logic to resolve the discrepancies once the data are automated represents a coarser and less sensitive means than careful decision-making on a case by case basis by an experienced resource specialist with photos, basemaps, and related maps at hand.

Some of the data employed in the development of the GIS for both the Eagle River and Anchorage Bowl study areas was in a format which required rescaling and adjustment to the imagery before it was in a form amenable to integration into a manuscript map. In the rescaling process a combination optical/manual procedure was followed, involving the use of an optical pantograph. A Kargl reflecting projector, with a rated distortion factor of less than 0.01%, was used. Collateral maps were placed on a platform and their images were optically projected upward onto a glass surface. Enlargement or reduction of the original collateral maps occurred as the map-to-lens ratio was changed. Fastening the mylar copy of the topographic basemap onto the projection glass allowed the collateral to be reformatted to the basemap scale of 1:25,000. In certain cases, the enlarging or reducing process was repeated in order to achieve the required scale. After the information was adjusted to the basemap scale, it was manually transferred onto the drafting film. Care was taken to ensure that all information was transferred accurately, and that no transposition of information codes occurred. An edit check of the hand drawn map compared it to the original data.

The physical characteristics and interpretive values of the phenomena mapped for this project were derived largely from the collateral maps and documents which were provided to ESRI staff by the Department of Planning of the Municipality of Anchorage. The color and color infrared imagery and the basemaps were used to verify, rectify, and clarify the distribution and areal extent of the phenomena mapped from the collateral. Patterns were adjusted to match the imagery and the basemaps. The imagery and basemaps thus acted as geographic "controls" for reformatting and for correcting cartographic inconsistencies between the various data variables. In two cases the imagery was used as the basis for the photo-interpretation of new data. Both vegetation and landforms in Eagle River and Anchorage Bowl were photo-interpreted as part of this study. Both efforts contributed substantially to the data included in the GIS. A brief description of each effort is provided.

Vegetation Interpretation and Mapping

The vegetation maps of Eagle River and Anchorage Bowl, including Fire Island, were prepared from stereoscopic interpretation of existing 1:63,360 color infrared (1978) imagery. The original color imagery was enlarged to black and white chronaflex copies at a niminal scale of 1:25,000 in order to aid in the final delineation of vegetation boundaries and the refined delineation of a number of the other data variables. The standard vegetation classification presently being employed by the US Forest Service in mapping vegetation in Alaska was used in this study. In areas where more than one vegetation type was present, the primary, secondary and tertiary types were interpreted and coded. A special code scheme was structured to allow the efficient storage of such combinations in a four digit code. Field work was not conducted as part of this effort.

Landform Interpretation and Mapping

The landform maps of Eagle River and Anchorage Bowl were prepared from stereoscopic interpretation of existing 1:12,000 color aerial imagery and from existing geologic mapping and reporting. That of Fire Island was prepared from the interpretation of 1:24,000 black and white photography and from existing geologic mapping and reporting. Field work was not conducted as part of this mapping effort. Subsurface information that could not be interpreted from aerial photography was obtained from the existing geologic mapping. The characteristics used to identify the different landforms included the following: topography; drainage patterns (type and texture); photographic tone or color; gullies, or other erosional features; land use; vegetation; and other features such as outcrops and fractures. The landforms were classified into groups determined by their mode of origin because similar geologic processes usually produce similar topography and soil properties. These properties also determine and/or influence the development and appearance of other attributes like drainage, erosion, and vegetation. These factors in turn largely determine land use capability. The units mapped are based on those landforms and geologic units which possess the highest degree of interpretive and predictive value for the evaluation of land capability and environmental conditions. The units describe not only land surface form but also take into acccount the geologic materials probably present to a depth of about 20 feet. Complex landforms can take to forms: layered systems where two different geologic materials are present, such as $\frac{Ft}{Gt}$ terrace over glacial till, or arealy interspersed system: $N + \frac{Gt}{N}$, metamorphic bedrock and glacial till over metamorphic bedrock.

Other data employed in the system were interpreted from topographic maps or derived from collateral sources. In all instances, delineations were matched to both the imagery and basemaps. These data are identified in two general classes: interpreted environmental data and pre-interpreted geo-environmental data. The general types of data prepared for automation are outlined below by these classes and by the manuscript map on which they were placed.

Manuscript Map #1

Integrated Terrain Unit Map

INTERPRETED ENVIRONMENTAL DATA

Surficial Geology

The collateral surficial geology maps identifying types of surficial deposits, were refined to match the visible pattern on the imagery and slope breaks of the topographic and soil phase maps. Care was taken to ensure consistency with landform types.

Slope Gradient

Slope gradients were interpreted from 1:37,000 scale topographic sheets having 50 and 100 foot contour intervals. Polygons with slopes greater or less steep than the coded slope value but below 10 acres in resolution were not mapped. Slope delineations are broader and less detailed than those which might be derived from the soil phase maps. The following slope classes were used: were 0-3%, 3-7%, 7-12%, 20-30%, 30-45% and 45% or greater. To interpret the slope, a scale having different line densities corresponding to contour line density at the specified slope classes was used to compare the contour lines on the topographic map. A mylar slope map was prepared by drawing polygons around areas of homogeneous line density.

Surface Form

Surface form was mapped through the stereographic interpretation of aerial photographs and a review of the contour line configurations on the topographic sheets. Mapping unit size varies from a few to several hundred acres. Topographic basemaps were used to verify the photo-interpretations of the units.

Soil

Soils were derived primarily from USDA, Soil Conservation Service Soil Survey data. The majority of the study area, with the exception of the urbanized portion of Anchorage and small areas around the fringe of the survey areas, were covered by existing mapping. In fringe areas, soils were interpreted and extrapolated using the imagery, adjacent soil survey lines, and soil survey descriptions. In surveyed areas, dynamic features such as floodplains and tidal flats were updated to match the conditions shown on the imagery. In addition, all data were rectified from the image-based system to the basemaps. The soil overlays prepared for this study were delineated to the series level with a polygon resolution generalized to ten acres.

PRE-INTERPRETED GEO-ENVIRONMENTAL DATA

Nine separate data planes representing pre-interpreted geo-environmental assessments were overlaid and merged with the basic terrain features listed earlier. Boundaries were adjusted to fit the general terrain features. However, no substantial changes were made which added or subtracted from these data as originally interpreted. Some inconsistency between these pre-interpreted data and the basic terrain data are evident, however, they reflect different levels of classification as well as cartographic generalizations or local conditions. The pre-interpreted data include the following: slope stability, mass wasting, seismically-induced ground failure, floodplains/coastal flooding/erosion, foundation conditions, groundwater, permafrost, wetlands, and habitats.

Manuscript #2

Land Use/Seismic/Elevation Map

INTERPRETED ENVIRONMENTAL DATA

Land Use

These data were derived from existing detailed maps of land use patterns. They were generalized to a ten-acre resolution and then photo-checked to ensure currency and accuracy of line placement.

Elevation Province

These data were derived from the topographic basemaps and represent a generalization of select elevation contours.

PRE-INTERPRETED GEO-ENVIRONMENTAL DATA

Earthquake Intensity

This very general data set based on an existing collateral map was drafted with no change onto the land use map to facilitate automation.

After all of the variables were mapped and integrated, the polygons or line segments delineated on the individual data maps were assigned code numbers. These code numbers referred to the different values or characteristics which each such delineation represented. The code numbers were then either applied directly to the manuscript map itself or were referenced, in turn, to sequential numbers applied to the map. In either case, the numbers used were related to the polygons shown on the map by being placed within the polygons.

Each module was then edgematched to its adjoining module. Edgematching is a process of comparing the shared borders of adjoining map modules. Edgematching was done to correct any problems occurring along the borders due to the adjoining maps having been created independently of one another. Where lines of any kind crossed from one module into the other, these were checked to be sure that they were properly located and that they matched. A check was also made to be sure that the code assignments along each side of the shared border were correct and were consistent with those across the border in other modules.

C. Manuscript Maps

The maps created for Eagle River and Anchorage Bowl are outlined in this section. Appendices A and B contain a detailed discussion of them, encompassing the following considerations: the reasons for incorporating each data type in the data base; the collateral information used to prepare each manuscript map; the implications of the source map's scale and resolution; the process used to transfer information from the source map to the stable base manuscript map; the interpretive decisions involved; and the reliability and quality of the information provided on each manuscript map.

Manuscript No. 1 - Integrated Terrain Units

Manuscript No. 1 is a polygon map delineated at a scale of 1:25,000, comprising twenty data categories. In virtually all instances, the classification used for a given data category was consistent with that provided in the collateral information or indicated by the Department of Planning. For example, soil and surficial geology were both mapped using the data classification provided in the original soil and geology surveys. In some instances, a classification was modified to account to a higher level of data resolution in the present study than in the original one. In the creation of the manuscript maps for each of the ten map modules, each data variable was manually cross-compared and then checked against the basemaps and imagery before being delineated on the manuscript. The data planes with the highest accuracy and reliability were drafted first. Those with the least were drafted last. The addition of each new data plane typically resulted in the drafting of additional lines on the manuscript; however, due to the integration process, proportionately more were added for the highly resolved data planes than for those with low resolution and reliability. As indicated earlier, some of the source data was derived from interpretations made at general scales. In these case, boundaries were adjusted to correspond with existing lines where appropriate.

Manuscript No. 2 Land Use/Seismic/Elevation Map

Manuscript No. 2 is a polygon map delineated at a scale of 1:25,000, comprising three data variables. Polygons were used to represent land uses, seismic zones, and elevation zones. In general, data were composited on the manuscript but not integrated. All data were nonetheless checked against the basemaps and imagery to ensure accuracy and currency.

Chapter III

Data Automation

III. AUTOMATION

A. Introduction

The central feature of this study was the automation of all of the geographic data collected for the data bank and regional analyses. The information prepared for automation was in two basic formats: the manuscript maps and the codes for those maps. The maps were automated by a process called digitizing. Lines defining each of the polygons were stored in the computer as series of x,y coordinates connected by straight line segments. Given that the polygon coordinates were closely spaced and the connecting straight lines very short, the automated polygons closely approximated the curved lines drawn on the original manuscripts. The codes, which describe the attributes of the environmental variables represented on the manuscripts, were keypunched directly into the computer. A series of programs were then run on both the map and code data to eliminate errors and inconsistencies and to prepare the information for analysis, modeling, and computer mapping. This procedure was followed for each of the two manuscripts for each of the ten map modules comprising the study area. Once completed, the polygon information was converted into a parallel grid format. This in effect involved overlaying a uniform rectilinear grid over the automated maps and assigning an appropriate value for each variable to each cell based on the predominant characteristics in that cell. The result of this and other processes was the creation of a grid multi-variable file (MVF) incorporating all the data on the two manuscripts into one code string for each grid cell in the entire Eagle River/Anchorage Bowl area.

In addition to the maps and basic code information, a matrix of interpreted data was automated for mapped soils data. An expanded code of this type represents an efficient form of recording, storing, and modifying information which is, by nature, subject to change.

Derived data items were also added to the data base. These items are those which obtain from basic and/or interpreted data. They include distance searches, in which cells are identified in terms of their distance from such mapped phenomena as water and developed land. These derived data were included in the data base with the basic and interpreted data.

The final automated data base contained data developed by these three distinct processes. The spatial configuration and essential attributes of the mapped units were automated by a process of coordinate digitizing and code keypunching. These data were subsequently subjected to procedures which created a parallel grid file. The actual information in the system, however, was expanded by the addition of select matrix descriptions and interpretations. These were keypunched into the system and structured as associative tables in the x,y coordinate files. The data stored in the grid files were further expanded by the process of evaluating each grid cell relative to its distance from select geographic phenomena and the number of occurrences of select phenomena within a specified radius.

B. Methodology

The technical process involved in transferring geographic data from the manuscript maps and associated codes to the automated data files can be divided into four major tasks. These can be described as follows:

1. Manuscript Map Preparation for Digitizing

Before any manuscript map was automated, it was carefully checked for errors and prepared for actual digitizing. The checking included examination for missing polygons or codes, extraneous lines, or problems which might cause confusion during digitizing. Next, a unique number was assigned to each of the two manuscript maps for each of the ten modules to distinguish it from all of the other files. Next, each manuscript map was prepared for digitizing by numbering the geographic reference tic points on each map in sequence from north to south. The origin point and centroid of each polygon were then marked.

2. Digitizing

Using a process termed "digitizing", all data recorded on the manuscript map were converted to machine readable form. A digitizer, a backlighted drafting table to which is attached a movable cursor, was used to make this conversion. As the cursor was moved horizontally and vertically over each manuscript map mounted on the digitizer table, electronic devices translated these movements into digital measurements in units of one thousandth of an inch. The numbered tic marks were digitized first. The cursor was moved to each tic mark and, by pressing a key, a record was sent to a mini-computer for storage. After all tic marks were digitized, each polygon on the map was similarly recorded and stored in order of the sequence number for each, described above. The digitized record indicates the precise location in x,y coordinates of all mapped information with respect to the tic marks. The tic marks represent known points of latitude and longitude to which all of the mapped information could be referenced. Data digitizing and all subsequent data automation processes utilized PIOS (Polygon Information Overlay System) and GRID software sets, developed by ESRI during the past ten years.

The digitizing process involved systematically recording data according to a standard set of procedures. For polygon data, this involved selecting and recording a string of x,y coordinates, termed "vertices", where a change in direction occurred along the border of each polygon. Curves were approximated by short straight line segments. All polygons were automated as closed units, digitized in a specific order, and sequenced accordingly. When donut polygons occurred, the innermost polygons were digitized first. Digitizing then proceeded to the polygon which contained the donut polygon or polygons. PIOS software resolved the hierarchy.

3. Editing of Digitized Files

After each manuscript map was digitized, the stored record was transferred from the digitizer's mini-computer to a large computer for further processing. The first step in the edit process was to shift and scale the coordinates of each file relative to tic marks which provided geographic reference. From this step, lists were generated which allowed tic identification numbers, tic coordinates, sequence numbers, donut level identifiers, and code numbers to be checked. Because of machine errors during digitizing, it was sometimes necessary to redigitize a polygon or a series of polygons. After these editing steps were completed, changes were made and the revised files were stored. At this stage, all information stored in the file was numerically accurate. After these machine edits, a plot of each manuscript map for each module was generated. These computer maps were used to visually check the accuracy of the digitized and machine edited x,y coordinates against the original manuscript maps. This step allows identification of missing or duplicated polygons, unacceptable configurations, code errors, and code offsets (for legibility).

Following the visual edit of polygons, the numeric attribute codes which had been keypunched into the computer were associated with their appropriate spatial unit. Each of the data variables in the system was plotted out at the manuscript scale and compared against manually prepared overlays of the collateral data. These plots, termed "dropline plots", were used to ensure that each data variable was accurately delineated and coded in the computer data file. Most data errors discovered in this edit process were corrected using PIOS edit software. For cases where entire polygons were missing, the original manuscript map was remounted on the digitizer and polygons in error were digitized. This redigitized information was merged into the previous information set. Perfect alignment was ensured by redigitizing of the tic marks as well.

4. Final File Generation

This process involved the creation of final polygon files for the study area as well as the creation of a parallel grid cell file. Two preliminary steps were required for completion of the x,y coordinate files. The first step involved the conversion of the digitized tic coordinates, which were referenced in inches, to a geographic coordinate referencing system such as UTM. The next step involved the merging of the individual files created for each map module into a single file for the two portions of the study area, Eagle River and Anchorage Bowl. At the completion of this step, the data files were in their final polygon format.

Due to the number of columns necessary to store the terrain unit data variables for each polygon, it was necessary to create two separate data records. The first was a 16 column I.D. record associated with the digitized x,y data coordinates. The second was a 38 column record which contained for each polygon the proper codes for each variable. In order to produce a final data file, it was necessary to join these two records together. The polygon I.D., or sequence number, was a component of both of these records and was used as the merge identifier. At this point, the terrain unit polygon file was complete. A similar process was utilized for the land use/seismic manuscript.

Following completion of the final polygon files, a grid cell format data file was created. Using a series of ESRI computer programs including GRIPS (Gridded Information from Polygons), the polygon data files were converted to a grid cell format data file. In effect, a uniform grid with a cell size of 0.617 hectares (c. 78.5 meters on a side) was superimposed over the polygon data in each of the x,y coordinate files and each cell was assigned a code corresponding to the unit or the value of the unit in which it was located. This process resulted in the creation of a number of single variable grid files. These were subsequently merged together to create a multi-variable file of all of the grid data. The complete multi-variable grid file created for the Anchorage Coastal Study contains all of the data variables contained in the two manuscript maps and the interpretive data from the soil expansion matrix. Certain simple data items were packed into one position in the multi-variable file to save space. The grid cell data bank for the Anchorage Coastal Study is in two separate sections. The Eagle River portion measures 340 rows by 247 columns with 34 positions for data for each cell. That for Anchorage Bowl measures 318 rows by 448 columns.

C. Interpretive and Derived Data

The basic data files created for the study were expanded to include interpretive and derived data. The interpretive data are added by keypunching numeric codes outlined on the soil expansion matrix. The derived data were generated through the manipulation of data which were already automated. This involved the execution of a number of simple and complex distance search procedures. The interpretive and derived data encompassed in the GIS are described in the following subsections.

Expansion Matrices

During the mapping phase of the study, soils were identified only by unit names. These names alone do not provide the user with either a decription or an interpretation of the unit. This type of soil information was incorporated into the system as an "expansion matrix", which provides a series of coded descriptions and interpretations for each soil series mapped. These values were entered into the computer as numeric codes associated with the code for the unit itself. A separate legend provides an explanation of the rating represented by each of the codes.

The soil expansion matrix automated for this study includes the following data characteristics.

- Agricultural Capability
- Physical Characteristics
  - Surface K Value
  - Subsurface K Value
  - Drainage
  - Depth
- Building Limitations
  - Local Roads
  - Septic Tank Absorption Fields
  - Shallow Excavation
  - Dwellings Without Basements
  - Dwellings With Basements
  - Small Commercial Buildings
  - Recreational Development
    - Campgrounds
    - Picnic Areas
    - Playgrounds
    - Paths and Trails

The complete expansion matrix is presented in Appendix C.

Distance Searches

Once all of the data for the study area were in a grid format, additional manipulations of the data were performed. These involved the application of both simple and complex distance search programs to the automated data. Simple search programs were used to determine the distance of each cell from water bodies, specified vegetation, developed land, and a number of other features. These features were originally encoded as basic data items in the form of polygons. For each feature, the computer determined the grid cells within a specified distance of that feature. Cells within that distance were coded consecutively from "0" for the feature itself, increasing outward as successive integers for each cell. Cells outside that distance were coded as 9999. Complex searches determined the number of occurrences of specified phenomena within a given distance of a cell.

Distance searches are indicated on the model outlines in the following chapter by the assignment of value for being proximate (within a specified distance) to a given phenomenon. A complex search was conducted for the Visual Quality model.

D. Programs

As indicated earlier in this chapter, the raw manuscript and code data were processed through a series of computer programs designed to ensure clean (error-free) data files and prepare the stored information for further analysis and display. Figures III-1A to III-1E portray the sequence of PIOS and GRID programs utilized for this study. Collectively, these illustrations document the flow of data through the system to create the final grid multi-variable file. The steps required for modeling and printing of maps are also illustrated. The function of each of the individual PIOS and GRID programs is outlined in Table III-1 and III-2

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FIGURE III-1A. DATA AUTOMATION

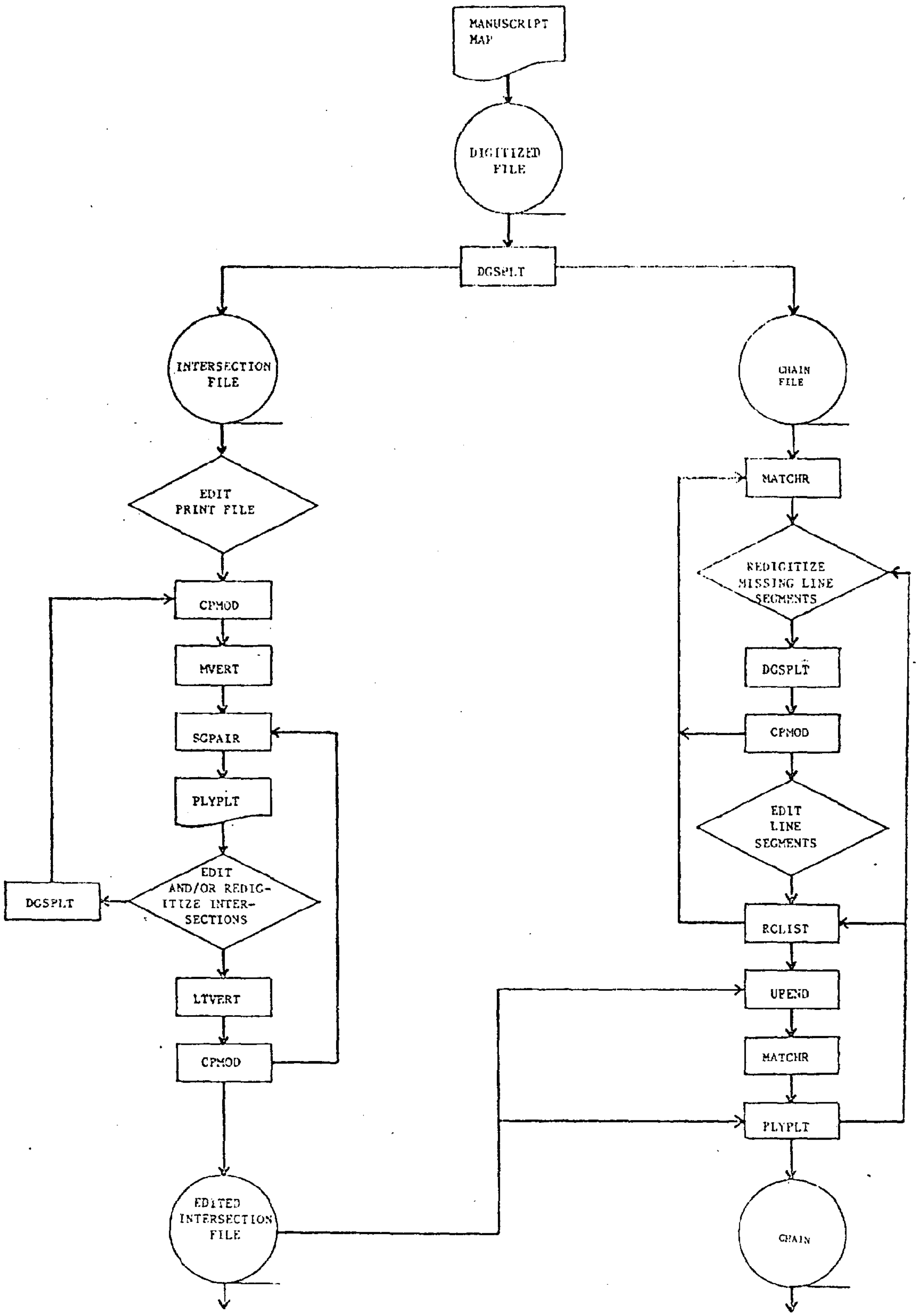


FIGURE III-1B
DROPLINE REVIEW

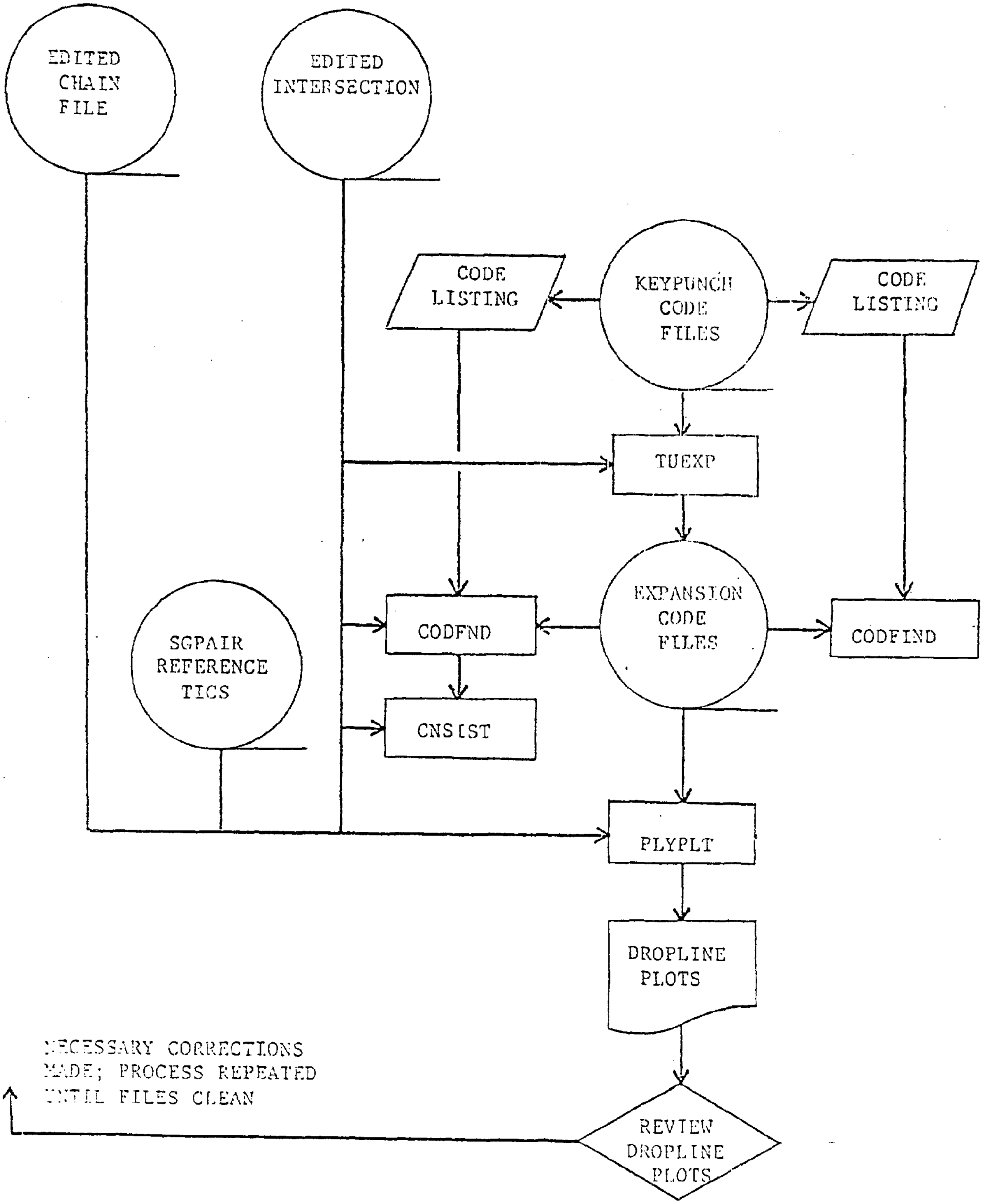
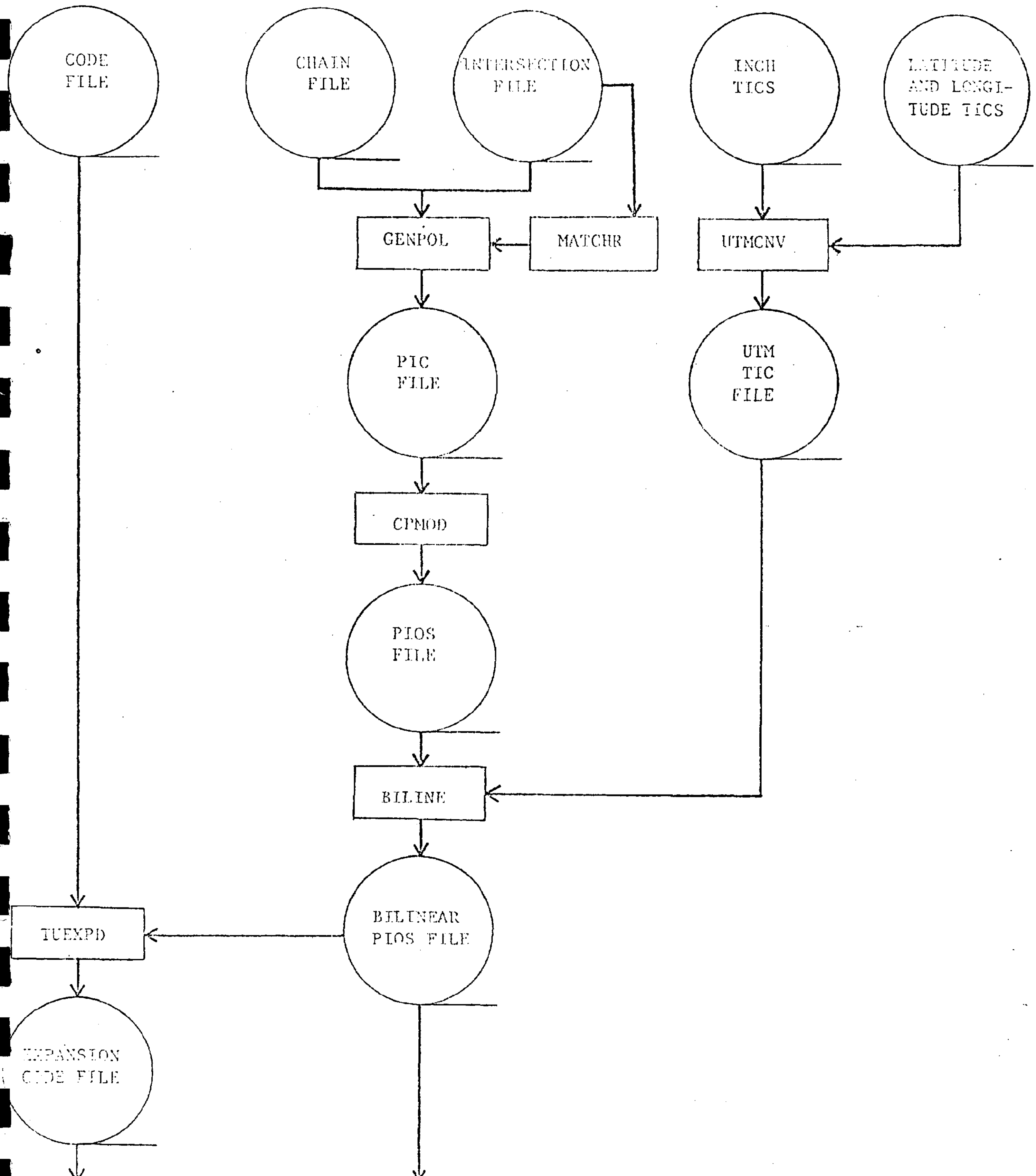
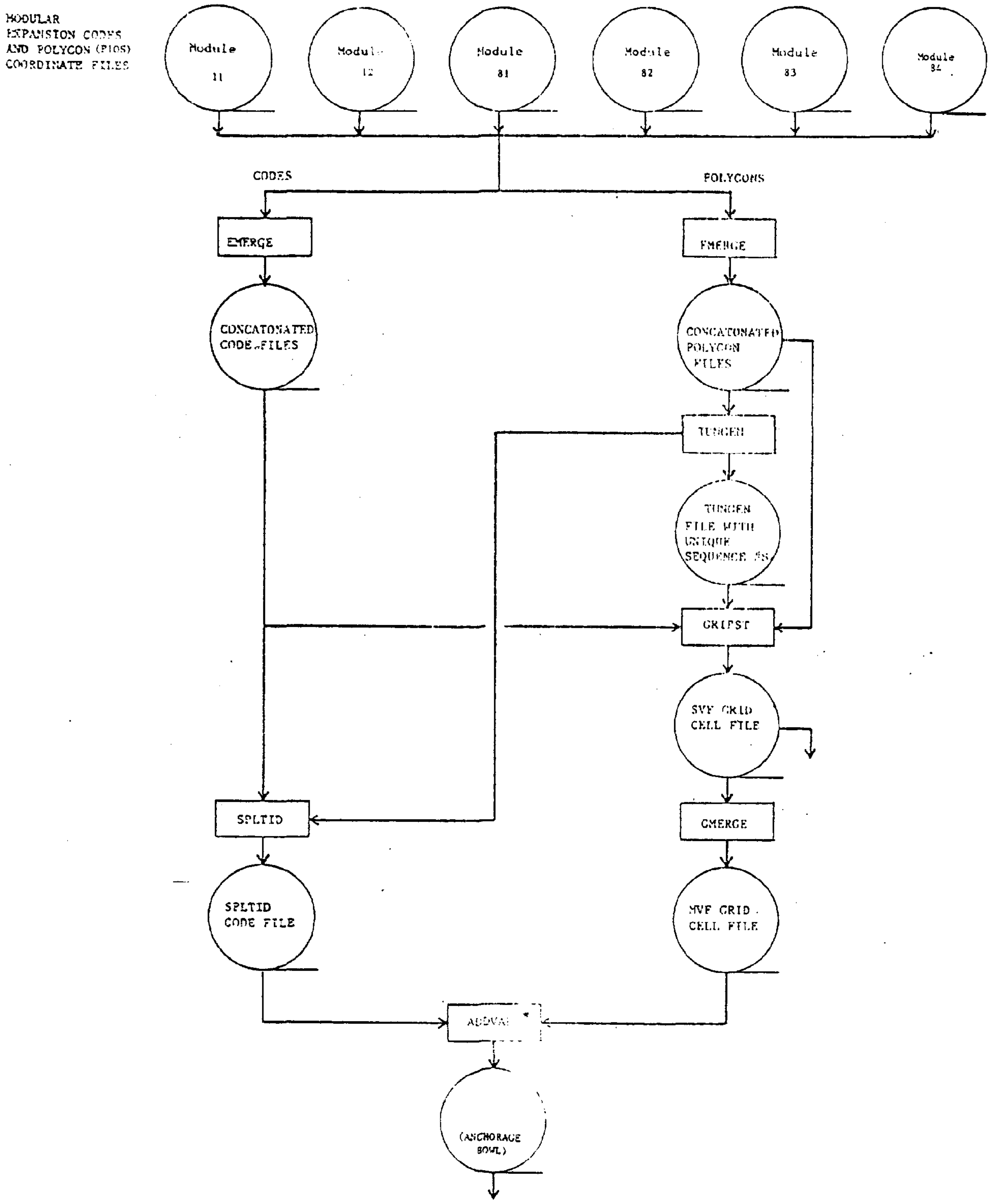


FIGURE III-1C
DATA REFORMATTING AND REFERENCING



PROCESS REPEATED FOR EACH OF TEN MODULES

FIGURE III-1D. MULTI-VARIABLE (MVF) DATA BANK CREATION
POLYGONS, LINES AND POINTS



(PROCESS REPEATED FOR MODULE 71, 72, 73, AND 74 TO PRODUCE MVF GRID CELL FILE FOR EAGLE RIVER)

*MAY BE REPEATED TO ADD MORE VARIABLE LAYERS

FIGURE III-1E
MODELING AND DATA MAPPING

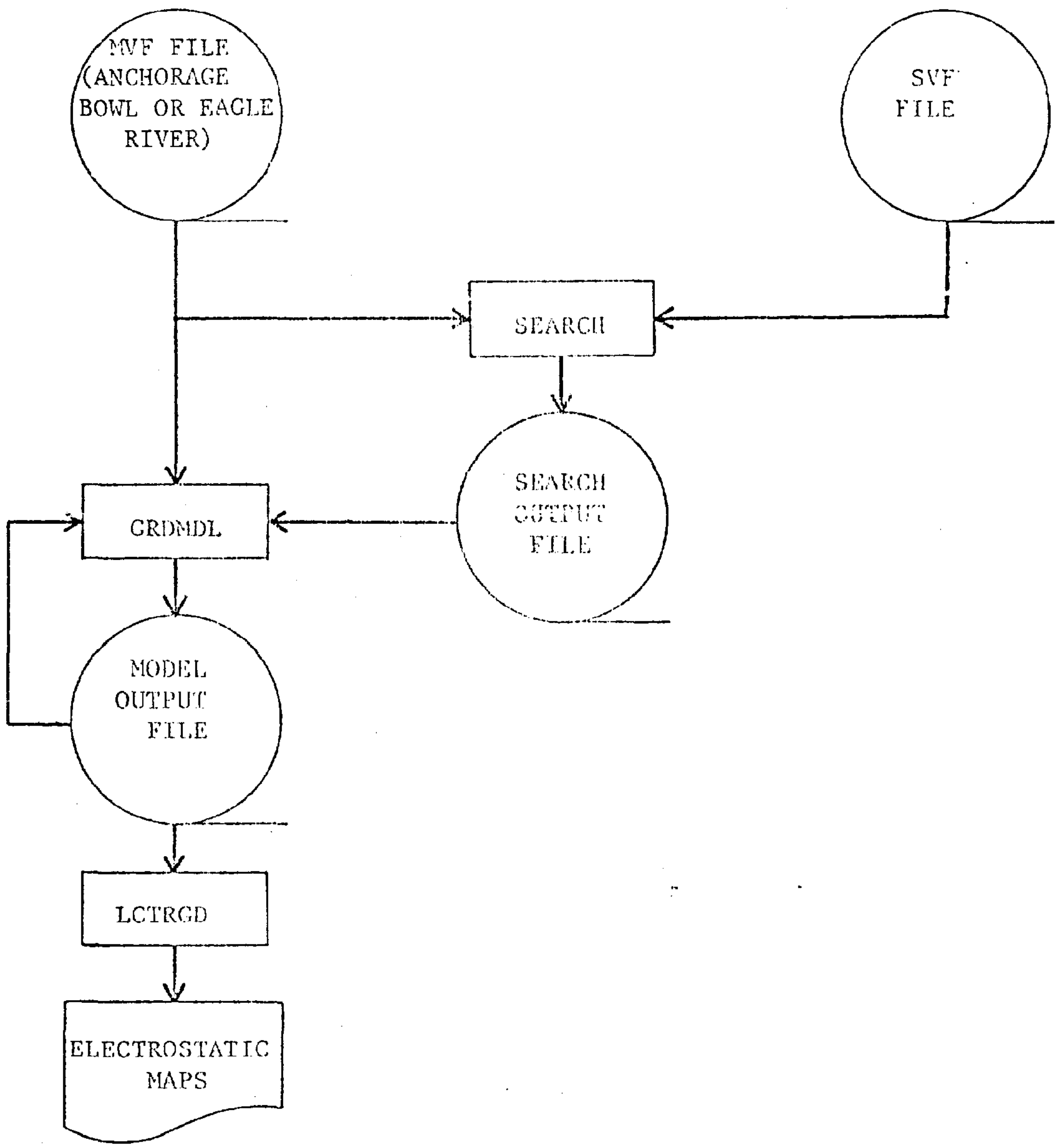


TABLE III-1

PIOS SYSTEM PROGRAM SUMMARIES

PROGRAMS ORIENTED TO CHAIN DIGITIZING

DIGITIZER CONVERSION AND SPLITTING - Converts digitized data for which a file has been generated to PIOS format, provides the capability to edit identifiers and insures alignment of coordinates through the use of the digitized tic locations.

MATCH RECORDS - Allows a separately digitized file of polygon boundary components ("chains" where each chain represents a boundary between the same two contiguous polygons), to be compared to a clean, but separate, file of points representing only intersections where three or more polygons come together. The two files are "matched" to identify whether or not each appropriate set of intersections on the one file has a corresponding "chain" boundary (to link the two points together) on the other file.

CHAIN/POLYGON MODIFICATION - Allows portions of a digitized chain or intersect file, which have been redigitized due to errors found in editing, (such as in the Match Record program), to be merged back into the correct portion of the parent file. Also allows miscellaneous other edits.

UPDATE CHAIN ENDS - Allows ends of "chain" boundary segments (which are inherently the same as intersections where three or more polygons come together), on a "chain" file to be compared to the corresponding intersection points on the Intersection file. If the "chain" end points have coordinates which are within a user specified tolerance of the intersection coordinates, they are matched and subsequently represented by the same point.

GENERATE POLYGONS - Allows a "clean" "chain" file to be combined with a "clean" Intersection file to generate a combined file in the PIOS format.

PROGRAMS ORIENTED TO DOUBLE DIGITIZING

DIGITIZER CONVERSION AND SPLITTING - Converts digitized data for which a file has been generated to PIOS format, provides the capability to edit identifiers and insures alignment of coordinates through the use of the digitized tic locations.

CHAIN/POLYGON MODIFICATION - Same as above, allows portions of a double digitized file, which have been redigitized due to errors found in editing, to be merged back into the correct portion of the parent file. Also allows miscellaneous other edits.

MATCH VERTICE - Consists of five programs which allow vertices of adjacent polygon common borders, which were separately digitized and may not coincide, to be matched and represented by a single point.

EDIT VERTICE - Allows strings of matchverted vertices which comprise adjacent polygon common borders to be analyzed and compatibility resolved.

DONUT - Allows calculation adjustments due to polygons completely contained within other polygons.

PROGRAMS USABLE SUBSEQUENT TO EITHER DIGITIZING CONVENTION

SEGMENT PAIRING - Assists file editing by identifying double digitized point "matches" and "non-matches" and transforms a subsequently clean double digitized file into a line segment file.

POLYGON PLOTTING - Creates final computer drawn plots of digitized polygons, lines, and points. For terrain unit plotting, the program allows elimination of common boundaries between polygons with the same code.

AUTOPLOT - Creates final computer drawn choropleth or zone shaded plots of digitized polygons (or polygons created using AUTOMAP II). The user can choose from twelve standard shading patterns or design his own.

DESCRIPTOR - Calculates the area, centroid, and minimum and maximum coordinates for each polygon and transforms numeric digitized codes to alpha, if desired.

BILINEAR - Allows a digitized map to be transformed into another coordinate referencing system, such as UTM, State Plane, etc.

OVERLAY - Calculates intersection coordinates of overlayed polygons, thus identifying newly created polygons.

STATISTICS - Consists of five programs which furnish various statistical printout listings.

UTILITY - Consists of nineteen programs which enhance data update, edit, and manipulation capabilities for both chain digitizing and double digitizing conventions.

POLYMODEL - Allows simple to complex modeling capabilities to be performed by a non-technically oriented user.

ROUTE EVALUATION - Allows a proposed route to be evaluated regarding impacts to intersected geographically disposed data.

GIRAS TO PIOS - Allows USGS generated Geographic Information Retrieval and Analysis System (GIRAS) data (includes LUDA) to be transformed into the PIOS System.

"COMMAND" - A user "friendly" question and answer on-line "menu" system which interacts with the user to prompt him regarding the various programs, and input options in the PIOS system.

TABLE III-2

GRID SYSTEM PROGRAM SUMMARIES

GRIPS - Stands for gridded information from polygons and allows a GRID oriented data file to be created from a polygon automated data file.

FILE GENERATION - Converts card image records of heterogeneous data to single variable file structure.

RECORD GENERATION - Converts card image records of homogeneous data to single variable file structure.

CELL SPLIT - Doubles the number of rows and columns in a grid cell file matrix by creating 4 new cells from each of the input cells, and assigning the code from the old cell to each of the 4 new cells.

GRID MAP/MODEL - Allows two-dimensional printer maps of spatially identified data to be produced according to user specified cosmetic treatments.

GRIDMERGE - Allows several data files of one variable each, for the same study area, to be merged into one data file of several variables.

WINDOW - Allows the file creation or printout of a subarea of an automated file.

GRID MODEL - The portion of GRID MAP/MODEL which allows simple to complex modeling capabilities to be performed by a non-technically oriented user.

COLOS - Uses the output of a model which has assigned "cost" values to each grid cell within a predetermined geographic area, and determines a "least cost" corridor between any two points which a user may specify.

CELL UPDATE - Allows an automated data file to be updated.

SEARCH - Examines the geographic area around each cell in an automated study area for proximity to or number of occurrences of a particular geographic phenomenon.

GRIDPLOT - Provides pen plotter output for the GRID oriented system.

ELECTROSTATIC GRIDPLOT - Provides electrostatic plotter output.

COLORMAP - Provides color graphics of computerized data.

AREA CALCULATION - Calculates polygon areas of one variable subject to polygon outlines of another variable when the two are superimposed.

COMMAND INTERACTIVE GRAPHICS PACKAGE - A user "friendly" question and answer on-line "menu" system which interacts with the user to prompt him regarding the various programs, electives and options in the GRID system.

TOPO SYSTEM PROGRAM SUMMARIES

CONGRID - Converts digitized contour lines or random point data to a single variable file containing continuous surface data.

SHORTGEN - Enlarges a single variable file containing continuous surface data by doubling the number of rows and columns, and infilling by calculating values for the new cells. (This capability allows data to be automated using one-quarter of the original data.)

TOPO - Provides two-dimensional isoline contour plotter maps of topographic surface information.

SLOPE - Calculates slope from topographic elevation for mapping and/or modeling purposes.

ASPECT - Calculates the direction of slope from topographic elevation for mapping and/or modeling purposes.

CUT AND FILL - Uses a topography file to qualitatively relate cut areas to fill areas and quantitatively provide data regarding cut areas or regarding fill areas.

SUN INTENSITY - Uses slope, aspect, sun position, etc., data to calculate sun intensities based on times of day and day of year.

EXPOSURE - Identifies areas in a topographic data file seen and/or not seen from selected points and lines.

VIEWS - Produces three-dimensional or cross-sectional line drawing plotter displays of topographical, socio-economic, etc., data.

COMMAND INTERACTIVE GRAPHICS PACKAGE - A user "friendly" question and answer on-line "menu" system which interacts with the user to prompt him regarding the various programs, electives and options in the TOPO system.

Chapter IV

Computer Modeling

IV. COMPUTER MODELING

A. Introduction

The automated data base developed for Anchorage was used for purposes of regional land assessment and evaluation with particular emphasis on identifying lands appropriate for energy facility siting as well as general urban development. Working in conjunction with Municipality of Anchorage, ESRI processed thirteen conceptual models to assess the natural opportunities and constraints in the region, the capability and suitability of the land for potential uses, and existing and potential conflicts relative to those uses. At the outset of the study, ESRI and Municipality staff determined the analytical models to be developed and the general criteria for each. On the basis of these general criteria, ESRI staff specialists structured the logic and values for each of the models. Following the automation of the data base, ESRI staff programmed the conceptual models. As conducted during this study, modeling was both a developmental and iterative process. In some cases the models and programs were changed after a review of the maps by both ESRI and Planning Department specialists. Most of the models, however, were sufficiently well-considered at the start that they were not significantly modified on the basis of subsequent review.

As employed in this study, modeling represented a process by which the data mapped and automated for the study were manipulated in the computer to produce maps with evaluations of various environmental factors. Such evaluations were based on a set of assumptions regarding the positive or negative significance of particular features of the landscape to the relevant factor. For example, the relative importance of particular vegetation types to an evaluation of fire hazard and of individual slope categories to the evaluation of land capability for concentrated urbanization was assessed. All of the opportunity/constraint models were based upon the assignment of numeric values to different data variables. For example, in the opportunity/constraint model for fire hazard, coniferous forest was assigned a much higher value than was tundra. Each of the opportunity/constraint models contained a summation element which was used to determine the overall rating for each area. The value ranges for each category were carefully selected, particular attention being directed to ensure that known constraints received high constraint value. The weighting procedures used for the capability/suitability models relied on the assignment of ratings to each of the possible expressions of a number of general environmental considerations. In general, the most restrictive rating applicable to a given point was used as the overall capability/suitability rating for that point. As used in this study, land capability was conceptualized as the inherent capacity of the land to sustain development, taking into account natural promoting and constraining factors. More specifically, it referred to the inherent capacity of the total complex of land-based environmental patterns and processes to sustain a specific type of use without bringing about unusual environmental degradation or exposing people or investment to hazards or unusual costs. The conflict models were not summed, but used numeric scores to identify particular classes of conflict which could then be rated or ordered.

B. Methodology

Thirteen models were applied to the automated data base in order to analyze and evaluate natural constraints and opportunities in the Eagle River/Anchorage Bowl area, to assess land capability for specific uses, and to identify potential land use conflicts. Designed and evaluated by staff specialists at ESRI, the models were structured to provide a useful output to the resource analysis and planning process. They were directed by and are consistent with established and accepted principles of resource evaluation, and they are sensitive to the particular environmental conditions and interrelations existing in the Anchorage area. The assumptions guiding model development are implicit in the factors selected and the weights assigned. These assumptions and their relation to model development are discussed in detail in the main body of this report.

The models which were programmed and run for this study are:

<u>Opportunity/Constraint Analyses</u>
- Soil Erosion Potential
- Ecological Sensitivity
- Water Pollution Potential
- Visual Quality
- Fire Hazards

<u>Capability/Suitability Analyses</u>
- Recreation
- Conservation/Open Space
- General Development
- Concentrated Urbanization
- Energy Facility Siting

<u>Conflict Analyses</u>
- General Development/Ecologically Sensitive Lands
- Urban Residential/Industrial
- Residential/Commercial

Once programmed, each model was run in the automated geographic data files for the study area. All models were run in the 0.6 hectare grid multi-variable file developed from the original polygon data. This file included the following: basic data encoded in the initial process of automation; interpretive data encoded in the soil expansion matrix; and derived data developed through the process of distance searching. Some of the models required the development of sub-modeling routines to evaluate such complex considerations as local relief. The results of each of the sub-models were checked before they were channeled into the principal models. The map outputs were first checked by ESRI professional staff to ensure that the model had been programmed accurately and that the models had general conceptual integrity. The models and maps were then reviewed by Municipality resource specialists. The finalized models were then programmed for the production of the final grid electrostatic maps identified and described in the following chapter.

C. Model Outlines

Each of the models developed and programmed for evaluating the land resources of the Anchorage coastal area is outlined on the following pages. The outlines were designed to legibly convey the essence and salient characteristics of each model to both readers and programmers. Four columns were used to indicate model logic, data base factors, and value assignment. The first column indicates the general concept under consideration. This could be a data variable in the data base or, for capability/suitability models, the results of a previously-run opportunity/constraint model. General considerations such as flood potential and slope gradient tie in directly with the assessment of land capability/suitability for many kinds of developed land uses, including energy facility siting. The second column identifies the specific class of data in the grid cell data base which was being used to satisfy the analytical requirements of the general consideration. For example, six or eight different coded vegetation or landform types might be used in a given analysis. In some of the models, two or more data variables were grouped into one general consideration. The third and fourth columns identify the values assigned to each of the specific factors and variables. The third column identifies the value or rating assigned when the specific feature or condition was incident in a cell, the fourth when it was proximate to a cell (the distance used for this evaluation is shown in parentheses under the general consideration). For the complex search in Visual Quality, additional value was added when two or more features were proximate to a cell.

The opportunity/constraint models generally operated on an additive principle. In effect, each cell accumulated points in relation to the factors identified and weighted in each model. Value was normally added when a particular phenomenon or attribute was incident to a cell, but in some cases value was added when it was proximate to the cell. The values which were assigned to individual factors were positive ones; the higher the numerical total, the higher the ranking of level of constraint for each cell.

The capability/suitability models were rated models, rather than numerical ones. Each of the specific data classes within a general consideration was assigned a rating of high (H), moderate (M), low (L), unsuitable (U), or not rated (NR) for the specified land use. Implicit in the model outlines was the assumption that a class had a high (or not rated) value unless otherwise specified. Thus, the models penalized any cell with certain identified adverse conditions. For example, in the General Development Capability/Suitability model a few landforms, including glaciers, tidal flats, and floodplains, were rated as unsuitable, low value, or moderate value for general development. Other landforms not listed were assumed not to have less than a high rating for development (or are not rated for this use). This process was repeated for each consideration. Each consideration was then assigned an overall rating. Model summation rules indicated the procedures for assigning composite ratings. In general, the most restrictive (i.e., lowest) value became the composite rating, so a cell with three H, five M, and three L ratings by consideration would obtain an ultimate value of L. These rules are modified in certain instances to rate a high number of M values as L. The Conservation/Open Space model followed the same principles, but the highest values were the most restrictive.

The conflict models were based on the identification of discrete types of conflict, rating of those types, and assigning numeric codes to each. The first two conflict models compare existing conditions, the last assesses potential conflict. The first two identify existing conflicts between residential and commercial, as well as between residential and industrial. The last identifies areas where urban expansion is most likely to be in conflict with ecological values.

In some models binary ratings were used: OFF indicates that the analysis was terminated at that point for that cell and the lowest value was automatically assigned; SKIP also terminates the analysis for that cell, but an independent value will subsequently be assigned. Care was taken in all of the models to ensure against double weighting and against the possibility of an area with a clearly unsuitable condition receiving a high overall value and rating because of some other very positive conditions existing there. All modeled data were ultimately grouped into classes on the final maps produced in the study.

OPPORTUNITY/CONTRAINT MODEL
EROSION POTENTIAL

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Soil Characteristics	K	N	
Slope Gradient	0 - 3%	.245	
	3 - 7%	.746	
	7 - 12%	1.78	
	12 - 20%	3.60	
	20 - 30%	6.34	
	30 - 45%	10.71	
	> 45%	17.58	

SUMMATION RULES
K Factor values are multiplied to value for average slope gradient to determine computed soil loss in tons per acre-year.

Very high	3.960 and Greater
High Soil Loss	2.332 - 3.959
Moderate	.865 - 2.331
Low	.106 - .864
Very low	.030 - .105

Not rated

Water

OPPORTUNITY/CONSTRAINT MODEL
VISUAL QUALITY

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Proximity to Water	Ocean		
	< 500m		10
	500 - 1000m		5
	Streams/Rivers/Lakes		
	< 150m		10
Landform	(1st Element)		
	Bx, I, N, S	5	
	Ca, Cm, Cl, Ct	3	
	Cg	6	
	Cs, Cx	1	
	E	2	
	Fd, Fm	6	
	Ff	3	
	Fp, Fpb, Fpm	7	
	Fps, Fpa, Fpc, Fpo	4	
	Fsh, Fsw	2	
	Gg	10	
	Gm	8	
	Gt, Gto, Gty	4	
	Gtd, Gtf, Gtl	9	
	GF	3	
	GL	5	
	Le, Lt	5	
	Lp	1	
	Mc	9	
	Mct	5	
	O, Os	3	
	W	10	
Landform Type	(Multiply by 1st Element Value)		
	1	1	
	2	1.4	
	3	1.2	
	4	1.5	
	5	1.5	
	6	1.3	
	7	1.5	

VISUAL QUALITY, cont.

Vegetation - Primary Component (< 150m)	CF - tall	10
	CF - short	8
	DF/MF	8
	BS - tall	7
	BS - short	1
	S	0
	G	4
	T	7
	SW/FW	3
	Mud	1
	Rock	5
	Ice	5
	Cultural/Disturbed	Skip
Vegetative Edge	One other vegetation type within 150m	4
	Two other vegetation types within 150m	6
	More than two other vegetation types within 150m	8
Elevation Province	> 300m	5
Slope	7 - 20%	3
	20 - 30%	7
	> 30%	10
Surface Form	Undulating	1
	Complex	2
Erosion, Coastal	Rapid	2
Habitats	Fowl, Moose	1
Local Relief	Specific slope phases are aggregated into six slope groups. Each group is assigned value: 0 - 7% + 0; 7 - 12% + 2; 12 - 20% + 3; 20 - 30% + 5; 30 - 45% + 7; and GT45% + 10. The greatest value difference between different slope categories located within a radius of 1 km are recorded. The following matrix is employed	1 - 6

to generate value differences between contacts.

	0 - 7%	7 - 12%	12 - 20%	20 - 30%	30 - 45%	GT 45%
0 - 7%	0	1	2	4	5	6
7 - 12%	1	0	1	2	4	5
12 - 20%	2	1	0	1	2	4
20 - 30%	4	2	1	0	1	2
30 - 45%	5	4	2	1	0	1
GT 45%	6	5	4	2	1	0

<u>SUMMATION RULES</u>

Very High	37.1 - 50.0
High	30.1 - 37.0
Moderate	19.1 - 30.0
Low	10.1 - 19.0
Very Low	0 - 10.0

Cultural

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Landform	Floodplain (all types)	5	
	Tidal Flat	5	
	Emergent Tidal Flat	5	
Vegetation (< .2km)	CF	15	
	CF, BS	14	
	CF, S	13	
	CF, BS, S	14	
	CF, BS, FW	23	5
	CF, S, T	17	
	CF, S, FW	22	5
	DF	12	
	DF, S	16	
	MF	18	
	MF, BS	20	
	MF, S	19	
	MF, G	21	5
	MF, FW	22	5
	MF, BS, FW	24	5
	BS	7	
	BS, CF	9	
	BS, MF	10	
	BS, S	8	
	BS, FW	20	5
	BS, CF, S	10	
	BS, CF, FW	22	5
	BS, MF, FW	23	5
	SW	25	
	S	5	
	S, CF	8	
	S, DF	11	
	S, MF	14	
	S, BS	7	
	S, SW	20	5
	S, G	13	
	S, T	19	
	S, FW	20	5
	S, CF, BS	9	
	S, DF, FW	20	5
	S, MF, G	15	
	S, MF, T	17	
	S, MF, FW	23	5
	S, BS, G	10	
	S, BS, FW	20	5
	G	15	
	G, MF	19	
	G, S	13	
	G, FW	24	5
	G, S, FW	23	5
	T	18	
	T, CF	20	5
	FW	25	
	Mud	2	

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Vegetation, cont.	Water	SKIP	5
	Cultural	-5	-5
Habitat	Fowl	4	
	Moose	5	
	Anadromous Fish	4	
Land Use	Developed		
	< .2km		-5
	.2 - 1km		-3
	1 - 2km		-1
Elevation Province	> 300m	5	

SUMMATION RULES

Very high sensitivity	31 - 40
High sensitivity	24 - 30
Moderate sensitivity	18 - 23
Low sensitivity	8 - 17
Very low sensitivity	7 or less

Water

OPPORTUNITY/CONSTRAINT MODEL
WATER POLLUTION POTENTIAL

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Landform	Lake/Pond		
	< 150m		10
	150 - 500m		5
	Stream/River		
	< 150m		10
	150 - 500m		5
	Ocean		
	< 150m		10
	150 - 500m		5
Vegetation	Barren	2	
	Wetland (< 150m)	5	3
Geology	Fine-grained Deposits	3	
	Landslide Deposits	3	
	Bedrock	2	
Soil Drainage	Very Poor	5	
	Poor	3	
	Excessively Well	5	
Soil Limitations for Septic Tanks	Severe	5	
	Moderate	2	
Groundwater	< 20 ft.	5	
Permafrost	High (use wetlands in Eagle River)	2	
Habitat	Fish	5	
	< 150m		3
	150 - 500m		1
	Fowl	4	
	< 150m		2
	150 - 500m		1
	Moose	1	

SUMMATION RULES

Very High Potential	29 - 45
High Potential	22 - 28
Moderate Potential	17 - 21
Low Potential	11 - 16
Very Low Potential	0 - 10

Water

OPPORTUNITY/CONSTRAINT MODEL
FIRE HAZARDS

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Vegetation	CF	40	
	CF, BS	35	
	CF, S	35	
	CF, BS, S	35	
	CF, BS, FW	30	
	CF, S, T	35	
	CF, S, FW	30	
	DF	30	
	DF, S	25	
	MF	35	
	MF, BS	30	
	MF, S	30	
	MF, G	30	
	MF, FW	25	
	MF, BS, FW	25	
	BS	15	
	BS, CF	25	
	BS, MF	20	
	BS, S	15	
	BS, FW or BS, S, FW	10	
	BS, CF, S	25	
	BS, CF, FW	20	
	BS, MF, FW	15	
	SW	0	
	S	10	
	S, CF	25	
	S, DF	20	
	S, MF	20	
	S, BS	15	
	S, SW	5	
	S, G	15	
	S, T	10	
	S, FW or S, G, FW	5	
	S, CF, BS	20	
	S, DF, FW	15	
	S, MF, G	20	
	S, MF, T	15	
	S, MF, FW	15	
	S, BS, G	15	
	S, BS, FW	10	
	G	20	
	G, CF	25	
	G, MF	25	
	G, S	15	
	G, FW	10	
	G, S, FW	15	
	T	10	
	T, CF	25	
	FW	0	
	Mud/Rock	OFF	
	Water	SKIP	
	Cultural	SKIP	

FIRE HAZARDS, cont.

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Slope	0 - 30%	10	
	30 - 45%	25	
	> 45%	40	

SUMMATION RULES

Very high hazard	66 - 80
High hazard	46 - 65
Moderate hazard	31 - 45
Low hazard	16 - 30
Very low hazard	0 - 15

Cultural
Water

CAPABILITY/SUITABILITY MODEL
RECREATION

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Vegetation (Primary)	BS	M	
	SW	U	
	S	L	
	T	L	
	FW	U	
	Mud	U	
	Water	SKIP	
Slope	12 - 20%	M	
	20 - 45%	L	
	> 45%	U	
Surface Form	Complex	M	
Soil Drainage	Poor - Very Poor	M	
Land Use	Park	SKIP	
	Urban Developed	U	
	Residential > 500m		M
Visual Quality	Very High	M	
	Moderate	M	
	Very Low	L	
Ecological Sensitivity	Very High	L	
	High	M	
Wetlands	Wetland	U	
Mass Wasting	Highest Known Potential	U	

SUMMATION RULES

Ratings are scanned within each general category encompassing more than one factor, and the most severely constraining rating is used to provide the overall rating for the category. In effect, each general consideration - landform, soils, water availability, etc., - has a single rating when summation begins. The following summation procedures are used:

High Capability/Suitability	Not EQ M, L or U
Moderate Capability/Suitability	LE 6M and Not EQ L or U
Low Capability/Suitability	GT 6 M or LE 6 L or Not EQ U
Unsuitable	GT 6 L or GE 1 U

Park

Water

CAPABILITY/SUITABILITY MODEL
CONSERVATION/OPEN SPACE

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Landform	Fp, Fpb, Fpm, Fps, Fpc	M	
	Gg	M	
	O, Os	M	
	W	SKIP	
Ecological Sensitivity	Very High	H	
	High	H	
	Moderate	M	
Visual Quality	Very High	H	
	High	H	
	Moderate	M	
Wetland	Wetland		
	< 150m from water		H
	> 150m from water		M
Habitat	Fowl	H	
	Anadromous Fish	H	
	Moose	M	
Land Use	Urban/Developed/Disturbed Agriculture	U	

SUMMATION RULES

Ratings are scanned within each general consideration and the highest rating is used to provide the overall rating for the category. The following summation procedures are used:

High Capability/Suitability	GE 1 H
Moderate Capability/Suitability	Not EQ H
Low Capability/Suitability	Not EQ M or H
Unsuitable	GE 1 U

Water

CAPABILITY/SUITABILITY MODEL
CONCENTRATED URBANIZATION

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Landform	Cg	U	
	Fp, Fpb, Fpm, Fps, Fpc	L	
	Gg	U	
	Mc	L	
	Mct	L	
	O, Os	L	
	W	SKIP	
Slope	7 - 12%	M	
	12 - 20%	M	
	20 - 30%	L	
	30 - 45%	L	
	> 45%	U	
Soil Erosion	Very High	L	
	High	L	
	Moderate	M	
Soil Drainage	Poorly	M	
	Very Poorly	L	
Water Pollution Potential	Very High	L	
	High	M	
	Moderate	M	
Ecological Sensitivity	Very High	U	
	High	U	
	Moderate	L	
	Low	M	
Visual Quality	Very High	U	
	High	L	
	Moderate	M	
Land Use	Developed	SKIP	
	Agriculture	L	
Fire Hazard	Very High	U	
	High	L	
	Moderate	M	

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Ground Stability	Slope Stability		
	Lowest	U	
	Generally Low	L	
	Moderate	M	
	Mass Wasting		
	Highest	U	
	Moderate to High	L	
	Foundation Conditions		
	Poor	L	
	Fair to Poor	M	
Soil Engineering Limitations	Local Roads		
	Severe	L	
	Moderate	M	
	Dwellings with Basements		
	Severe	L	
	Moderate	M	
	Small Commercial Buildings		
	Severe	L	
	Moderate	M	
Seismic Hazards	Seismically-Induced Ground Ground Failure		
	Very High	L	
	High	M	
	Moderate	M	
	Earthquake Intensity		
	High Intensity	M	
	Knik Fault Zone	M	
Floodplain/Coastal Flooding/Erosion	100-yr. Floodplain	L	
	Coastal Flooding	L	
	W/Rapid Erosion	U	
Groundwater	< 20 ft.	L	
Permafrost	High Potential	M	
Wetland	Wetland	U	

SUMMATION RULES

Ratings are scanned within each general category encompassing more than one factor, and the most severely constraining rating is used to provide the overall rating for the category. In effect, each general consideration - landform, soils, water availability, etc., - has a single rating when summation begins. The following summation procedures are used:

High Capability	Not EQ M, L, or U
Moderate Capability	LE 8 M or Not EQ L or U
Low Capability	GT 8 M or LE 8 L or Not EQ U
Incapable	GT 8 L or GE 1 U
Developed	
Water	

CAPABILITY/SUITABILITY MODEL
GENERAL DEVELOPMENT

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Landform	Cg	U	
	Fp, Fpb, Fpm, Fps, Fpc	M	
	Gg	U	
	Mc	L	
	Mct	L	
	O, Os	L	
	W	SKIP	
Slope	12 - 20%	M	
	20 - 30%	M	
	30 - 45%	L	
	> 45%	U	
Soil Erosion	Very High	L	
	High	M	
Water Pollution Potential	Very High	L	
	High	L	
	Low to Moderate	M	
Ecological Sensitivity	Very High	L	
	High	L	
	Moderate	M	
Visual Quality	Very High	L	
	High	M	
Land Use	Developed	SKIP	
Fire Hazard	Very High	L	
	High	M	
Ground Stability	Slope Stability		
	Lowest	L	
	Generally Low	M	
	Mass Wasting		
	Highest	U	
	Moderate-High	L	
	Foundation Conditions		
	Poor	M	

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Soil Engineering Limitations	Local Roads		
	Severe	M	
	Septic Tanks		
	Severe	M	
	Dwellings without Basements		
	Severe	M	
Seismic Hazards	Seismically-Induced Ground Failure		
	Very High	L	
	High	M	
Floodplain/Coastal Flooding/Erosion	100-yr. Floodplain	U	
	Coastal Flooding	U	
Wetland	Wetland	U	

SUMMATION RULES

Ratings are scanned within each general category encompassing more than one factor, and the most severely constraining rating is used to provide the overall rating for the category. In effect, each general consideration - landform, soils, water availability, etc., - has a single rating when summation begins. The following summation procedures are used:

High Capability	All not rated or Not EQ M,L,or U
Moderate Capability	LE 6 M or Not EQ L or U
Low Capability	GT 6 M or LE 6 L or Not EQ U
Incapable	GT 6 L or GE 1 U

Developed
Water

CAPABILITY/SUITABILITY MODEL
ENERGY FACILITY SITING

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Elevation Province	40 - 100m	L	
	> 100m	U	
Slope	7 - 12%	M	
	12 - 20%	L	
	> 20%	U	
Surface Form	Undulating	M	
	Complex	L	
Soil Engineering Limitations	Local Roads		
	Severe	M	
	Shallow Excavation		
	Severe	M	
Geology	Sand in Hills	M	
	Sand by Lakes	M	
	Peat	U	
	Lake/Pond Sediments	L	
	Silt	L	
	Bootlegger Cove Clay	L	
	Colluvium	M	
	Landslide Deposits	L	
Flooding	100-yr. Floodplain	U	
	Coastal Flooding	U *	
Water Pollution Potential	Very High	L	
	High	L	
	Moderate	M	
Ecological Sensitivity	Very High	L	
	High	L	
	Moderate	M	
Land Use	Undisturbed	M	
	Urban, Park	U	
	Residential < .5km		U
Landform	Water	SKIP	
	> 1km from Ocean, River		U **
Seismic Hazards	Seismically-Induced Ground Failure		
	Very High	L	
	High	M	

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* Eliminate for water dependent type facilities
** Keep for water dependent type facilities

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Seismic Hazards, cont.	Earthquake Intensity		
	Unknown - Knik Fault Zone	U	
	High Intensities	M	

SUMMATION RULES
Ratings are scanned within each general category encompassing more than one factor and the most severely constraining rating is used to provide the overall rating for the category. In effect, each general consideration - landform, soils, water availability, etc., - has a single rating when summation begins. The following summation procedures are used:

High Capability/Suitability	Not EQ M, L, or U
Moderate Capability/Suitability	Not EQ L or U, or LE 6 M
Low Capability/Suitability	GT 6 M or Not EQ U, or LE 6 L
Unsuitable	GT 6 L or GE 1 U

Water

CONFLICT MODEL
URBAN RESIDENTIAL/INDUSTRIAL

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Land Use	Residential[a]		
	< 150m from Industrial[b]		3
	150 - 300m from Industrial		2
	300 - 500m from Industrial		1
	> 500m from Industrial		0
	Industrial	10	

(a) Codes 01, 02, 03, 04, 05
(b) Codes 08, 09, 11

SUMMATION RULES

Substantial Conflict	3
	2
	1
Negligible Conflict	0
Industrial	10

Study Area
Water

CONFLICT MODEL
RESIDENTIAL/COMMERCIAL

Consideration	Specific Data Class	Value (Incidence)	Value (Proximity)
Land Use	Residential[(a)]		
	Adjoining Commercial[(b)]		3
	< 150m from Commercial		2
	150 - 300m from Commercial		1
	> 300m from Commercial		0
	Commercial	10	

(a) Codes 01, 02, 03, 04, 05
(b) Codes 06, 07

SUMMATION RULES

Substantial Conflict	3
	2
	1
Negligible Conflict	0
Commercial	10

Study Area
Water

POTENTIAL CONFLICT MODEL
GENERAL DEVELOPMENT SUITABILITY/ECOLOGICALLY SENSITIVE LANDS

Ecological Sensitivity Rating	Capability/Suitability Rating for General Development					
	Developed	High	Moderate	Low	Incapable	Water
Very High	SKIP	10	6	4	1	SKIP
< 200m Distance	9	9	5	3		
High	SKIP	8	5	2	1	SKIP
< 200m Distance	7	7	4			
Moderate	SKIP	5	3	2	1	SKIP
< 200m Distance	4	4				
Low	SKIP	2	2	1	1	SKIP
Very Low	SKIP	1	1	1	1	SKIP
Water	SKIP	SKIP	SKIP	SKIP	SKIP	SKIP

SUMMATION RULES

Conflict Rating	
Level I (Substantial)	10
Level II	9
Level III	8
Level IV	7
Level V	6
Level VI	5
Level VII	4
Level VIII	3
Level IX	2
Level X	1
Developed Land	H
Water	L

Chapter V

Computer Mapping

Introduction
Methodology
Maps, Legends and Statistics
  Eagle River
    Basic Data
    Interpreted Data
    Opportunity/Constraint Analyses
    Capability/Suitability Analyses
    Conflict Analyses
  Anchorage Bowl
    Basic Data
    Interpreted Data
    Opportunity/Constraint Analyses
    Capability/Suitability Analyses
    Conflict Analyses

V. COMPUTER MAPPING

A. Introduction

The automated data files for the Anchorage Coastal Stu'y were used to produce a variety of maps for Eagle River and for Anchorage Bowl. The two types of computer maps produced for this study were maps of basic data and maps of modeled outputs. Basic data maps portray information directly from the data entered into the computer in the form of manuscript maps, codes, and expansion matrices; they illustrate select physical and cultural components of the landscape. Modeled outputs utilize information contained in the data base, but these data have been manipulated, restructured, and weighted according to the models outlined in the previous chapter. As noted previously, some models also utilize classes of information generated by separate sub-models. The model maps illustrate environmental assessments and evaluations of the region expressed in terms of general opportunities and constraints, specific land capability and suitability, and land use conflicts. A few of the maps identified in this section were produced at a scale of 1:25,000 in a pen plotter format with lines showing boundaries originally delineated on the manuscript maps. Most of the maps were produced in shaded gray tone symbolism. These maps illustrate basic and modeled data which are in a grid format rather than the original polygon format. They were produced on an electrostatic printer, also at a scale of 1:25,000. All maps thus register to the 1:25,000 scale basemaps. The basic sets of pen plotter maps of landform, vegetation, and slope, plus the terrain unit map, were plotted on mylar and overlay and register to individual 1:25,000 basemaps. The grid gray tone maps register to the composite basemap sets at 1:25,000 for Eagle River and Anchorage Bowl.

B. Methodology

Four sets of maps were produced in a pen plotter format on mylar at a scale of 1:25,000. One illustrates the actual integrated terrain unit manuscript maps as they were subsequently automated. Used in conjunction with print-outs of the terrain unit attribute codes, these maps provide a simple manual way of determining the environmental characteristics of any areas within the study area, and are a graphic representation of the original PIOS files. The other three sets are maps portraying the configuration of the data for landform, vegetation, and slope which were originally mapped in the terrain unit manuscript. Data were displayed at a scale of 1:25,000 and were structured in system map modules, corresponding to the standard topographic quadrangles of the area.

Fifteen maps illustrating basic environmental conditions in the area were produced in a shaded gray tone format. Representing gridded data, they were produced at a scale of 1:25,000, and were printed on translucent panels which fitted together to form individual maps illustrating the Eagle River and the Anchorage Bowl areas. The computer maps which were produced to illustrate basic environmental conditions in the study area are of two types - basic data and interpreted data. Basic data maps represent specific environmental characteristics mapped as part of the data base, such as landform, geology, and land use. Interpreted data are those which are based on evaluations or investigations involving environmental specialists. Some were mapped in the data base, such as floodplains, wetlands, or seismic hazards; others were incorporated by means of the soil expansion matrix, such as drainage or agricultural capability. Both types (basic data and interpreted data) typically represent aggregations of the data originally mapped, reflecting interpretive decisions regarding similarities between closely related environmental characteristics as well as the display options available with an electrostatic printer.

Thirteen computer maps illustrating the results of the application of theoretical models to the original data base were also produced. They illustrate data transformed and analyzed in a grid cell configuration at the 1:25,000 scale. All are based on the conceptual models outlined in the previous chapter of this report, which were programmed to manipulate the basic, matrixed, and derived grid data in the automated system. This process resulted in the creation of a data file for each model which stored accumulated values by cells. These values were subsequently grouped into classes and the computer was used to generate grid maps of the ranked and classed data on an electrostatic printer. As with the basic/interpreted data maps, all of the modeled data were portrayed in an electrostatic gray tone format at a scale of 1:25,000, and were printed on paper panels which fitted together to form individual maps illustrating the two study areas.

The maps produced for this study are listed below. These maps are characterized according to type (terrain unit, basic and interpreted data, and opportunity/constraint, capability/suitability, and conflict analysis maps) and format (polygon plots or grid electrostatic maps). Statistical summaries were produced for all of the maps.

Based on 10 modules, a total of 40 polygon plots were produced. Two electrostatic maps were produced for each of those listed below, with exceptions of Permafrost, Visual Quality, and Energy Facility Siting. Thus, a total of 53 electrostatic grid maps were created.

	Polygon/Mylar[1] by Module	Grid/Paper[2] by Study
Terrain Units	X	
Basic Data		
Elevational Province		X
Landform	X	X
Vegetation	X	X
Land Use		X
Slope	X	X
Soil	X	
Interpreted Data		
Wetlands		X
Floodplains		X
Habitats		X
Septic Suitability		X
Soil Drainage		X
Permafrost (Anchorage Bowl)		X
Agricultural Capability		X
Seismic Hazards		X
Opportunities and Constraints		
Soil Erosion Potential		X
Ecological Sensitivity		X
Water Pollution Potential		X
Visual Quality (Eagle River)		X
Fire Hazards		X
Capability/Suitability		
Recreation		X
Conservation/Open Space		X
Concentrated Urbanization		X
General Development		X
Energy Facility Siting (Anchorage Bowl)		X

Conflicts

Urban Residential/Industrial	X
Residential/Commercial	X
General Development Suitability/ Ecologically Sensitive Lands	X

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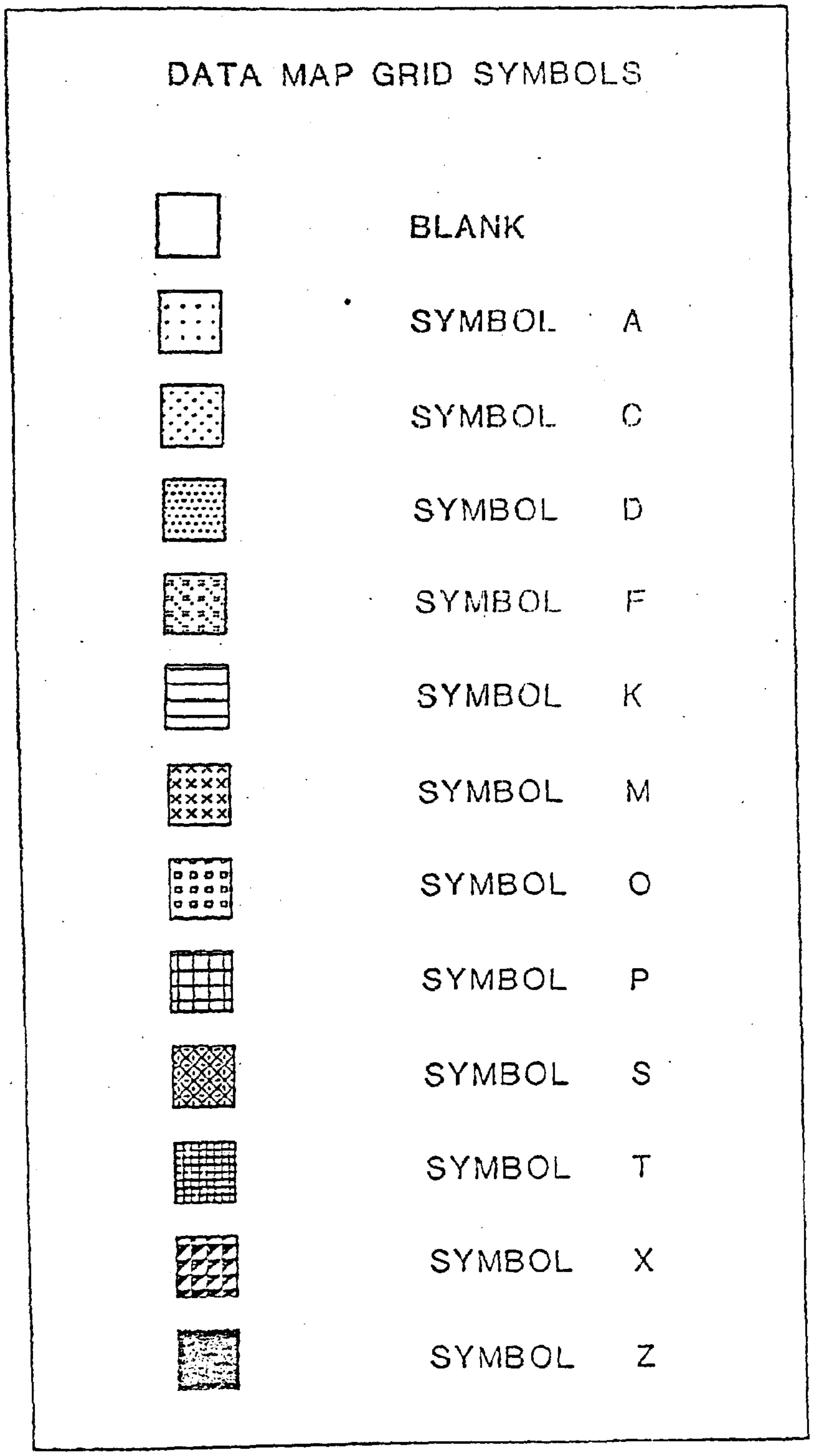
[1] 10 Modules: Anchorage (A-8) NE
NW
SE
SW
(B-7) NE
NW
SE
SW
Tyonek (A-1) NE
Fire Island Composite

[2] 2 Study Areas: Eagle River
Anchorage Bowl (includes Fire Island)

C. Maps, Legends, and Statistics

Each of the maps produced for the Anchorage Coastal Study was accompanied by a legend and statistics sheet describing the map symbolism and the areal extent of the mapped phenomena. A typed sheet for each of the maps is included at the end of this chapter. As indicated earlier, most maps were produced in an electrostatic gray tone format. The gray tones and their corresponding alpha symbols are illustrated in Figure V-1. An alpha symbol was used on each of the legend and statistics sheets to express the map pattern for each class of data on a given gray tone map. The gray tone maps are designed to aggregate the information which they convey. Those produced for the study area display data in twelve classes or less. When viewed from a distance, the data displayed on the gray tone maps appear to grade from white through shades of gray to black. Some of the maps portray qualitative data, others quantitative data. In general, the basic data maps are qualitative in nature, focusing on type rather than rating. However, where appropriate, the gray tone hierarchy was used to give a visual impression of importance or severity. The modeled maps are generally quantitative in nature, typically involving the ranking of areas within the region for their capability for specific types of land use. On most of the maps, the gray tone symbolism was selected to portray the ranking. In general, the sequence of light to dark was used to represent the sequence from high to low capability. The map illustrating conservation capability, for example, display ranked data in four classes from high to unsuitable. It, like most of the other maps, displays water as a separate data class. The codes portrayed on the polygon plots are those contained in the data classification system in Chapter I. Thus, a landform polygon wth a code of 1653000000000 would be "lowland glacial till"; a vegetation polygon with a code of 2112 would be "closed coniferous forest, white spruce, short stands, with low willow resin birches"; and a land use polygon with code 06 would be a commerical land use.

FIGURE V-1


DATA MAP GRID SYMBOLS
BLANK
SYMBOL A
SYMBOL C
SYMBOL D
SYMBOL F
SYMBOL K
SYMBOL M
SYMBOL O
SYMBOL P
SYMBOL S
SYMBOL T
SYMBOL X
SYMBOL Z

Eagle River
Map Legends and Statistics

Basic Data
Interpreted Data
Opportunity/Constraint Analyses
Capability/Suitability Analyses
Conflict Analyses

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
ELEVATION PROVINCE

Class	Symbol	Area - ha	Area - %
0 - 40m	C	2279.30	10.96%
40 - 100m	F	3637.24	17.50%
100 - 300m	P	7510.39	36.12%
> 300m	T	3464.95	16.67%
Water	Blank	3897.84	18.75%

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
LANDFORM (PRIMARY)

Class	Symbol	Area - ha	Area - %
Bedrock	Z	819.46	3.94%
Colluvial Deposits	C	116.71	0.56%
Eolian Deposits	D	---	---
Fluvial Deposits	F	2775.79	13.35%
Glacial Deposits	K	8211.28	39.50%
Glaciofluvial/glacio-lacustrine Deposits	M	3521.15	16.94%
Lacustrine Deposits	P	541.57	2.61%
Marine Deposits	S	820.08	3.94%
Organic Deposits	T	85.84	0.41%
Man-made Landforms	X	---	---
Water	Blank	3897.84	18.75%

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
VEGETATION (PRIMARY)

Class	Symbol	Area - ha	Area - %
Coniferous Forest	T	3773.72	18.15%
Mixed Forest	S	6103.65	29.36%
Deciduous Forest	P	2.47	0.02%
Black Spruce Forest	O	1557.41	7.49%
Wetland	Z	927.53	4.46%
Shrub	M	1391.29	6.69%
Grassland	K	53.11	0.26%
Tundra	D	765.12	3.68%
Barren, Snow and Ice	A	120.42	0.58%
Disturbed	X	2195.93	10.56%
Water	Blank	3897.84	18.75%

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
LAND USE

Class	Symbol	Area-ha	Area-%
Residential	O	2163.82	10.41%
Commercial/Institutional	P	161.79	0.78%
Industrial	T	---	---
Extractive	Z	108.07	0.52%
Transportation	S	305.68	1.47%
Park	K	947.29	4.56%
Agriculture	F	15.44	0.07%
Vacant Disturbed	C	65.46	0.31%
Non-developed	A	13124.34	63.13%
Water	Blank	3897.84	18.75%

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
SLOPE

Class	Symbol	Area - ha	Area - %
0 - 3%	C	4060.25	19.53%
3 - 7%	D	3293.28	15.84%
7 - 12%	K	1879.76	9.04%
12 - 20%	O	2113.80	10.17%
20 - 30%	P	2369.46	11.40%
30 - 45%	T	1285.69	6.18%
> 45%	Z	1889.64	9.09%
Water	Blank	3897.84	18.75%

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
GEOLOGY

Class	Symbol	Area - ha	Area - %
Alluvium	C	6736.62	32.40%
Sand	F	---	---
Peat, Lake or Pond Sediments	M	729.92	3.51%
Silt, Bootlegger Cove Clay	O	863.31	4.15%
Glacial/morainal/marine deposits	P	3615.63	17.39%
Colluvium	K	3258.70	15.68%
Landslide Deposits	T	---	---
Bedrock	Z	1687.71	8.12%
Man-made Fill	X	---	---
Water	Blank	3897.84	18.75%

EAGLE RIVER
BASIC DATA MAP LEGEND/STATISTICS
SOIL

Class	Symbol	Area - ha	Area - %
Sandy Loam	C	69.78	0.34%
Silt Loam	D	14618.14	70.31%
Gravelly/stony Silt Loam	K	663.84	3.19%
Mucky Silt Loan	O	6.79	0.03%
Peat	P	500.20	2.41%
Riverwash, Gravel Pits	S	167.97	0.81%
Rock Outcrops	Z	---	---
Cryaquents/Cryorthents	X	865.16	4.16%
Urban	A	---	---
Fire Island	A	---	---
Water	Blank	3897.84	18.75%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
WETLANDS

Class	Symbol	Area - ha	Area - %
Patterned Open Complex	D	---	---
Non-patterned Elongated Complex	F	560.72	2.70%
Lakeside Bog	K	35.20	0.17%
Old River Terrace Complex	M	713.86	3.43%
Concentric Closed Complex	O	6.18	0.03%
Forested Closed Basin Bog/swamp	P	59.28	0.29%
Non-forested Bog or Wet Meadow	T	12.97	0.06%
Large Freshwater Marsh/Coastal Wetland	Z	627.41	3.02%
Non-wetland	A	14876.27	71.56%
Water	Blank	3897.84	18.75%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
FLOODPLAINS

Class	Symbol	Area - ha	Area - %
No Flooding	A	14463.14	69.57%
100-yr. Floodplain	O	1152.31	5.54%
Coastal Flooding	P	1259.76	6.06%
Coastal Flooding with Slow to Moderate Coastal Erosion	T	16.73	0.08%
Coastal Flooding with Rapid Coastal Erosion	Z		
Water	Blank	3897.84	18.75%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
HABITATS

Class	Symbol	Area - ha	Area - %
Fish	D	51.87	0.25%
Fowl	F	---	---
Moose	K	7526.44	36.20%
Fish + Moose	P	36.43	0.18%
Fowl + Moose	S	804.64	3.87%
Fish + Fowl + Moose	T	---	---
No Habitat	Λ	8644.79	41.58%
Water	Blank	3725.55	17.92%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
SEPTIC SUITABILITY

Class	Symbol	Area - ha	Area - %
Severe limitations	T	14840.45	71.38%
Moderate limitations	K	810.20	3.90%
Slight limitations	C	212.43	1.02%
Not rated	X	1028.80	4.95%
Water	Blank	3897.84	18.75%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
SOIL DRAINAGE

Class	Symbol	Area - ha	Area - %
Very poorly drained	Z	500.20	2.41%
Poorly drained	T	3109.26	14.96%
Somewhat poorly drained	P	235.28	1.13%
Moderately well drained	K	313.70	1.51%
Well drained	F	11952.27	57.49%
Somewhat excessively drained	D	67.31	0.32%
Excessively drained	C	713.86	3.43%
Not rated	X	---	---
Water	Blank	3897.84	18.75%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
AGRICULTURAL CAPABILITY (SOILS)

Class	Symbol	Area - ha	Area - %
Class II	C	238.37	1.15%
Class III	D	1582.11	7.61%
Class IV	F	11546.55	55.53%
Class V	K	---	---
Class VI	P	1327.69	6.39%
Class VII	S	1164.04	5.60%
Class VIII	Z	---	---
Not Rated	X	1033.13	4.97%
Water	BLANK	3897.84	18.75%

EAGLE RIVER
INTERPRETED DATA MAP LEGEND/STATISTICS
SEISMIC HAZARDS

Class	Symbol	Area - ha	Area - %
Low-moderately low ground failure susceptibility			
Unknown surface rupture potential	C	5657.80	27.21%
Lower earthquake intensities	D	3895.37	18.74%
Higher earthquake intensities	F	4593.18	22.09%
Moderate ground failure susceptibility			
Unknown surface rupture potential	K	904.68	4.35%
Lower earthquake intensities	N	1533.32	7.38%
Higher earthquake intensities	O	296.41	1.43%
High-very high ground failure susceptibility			
Unknown surface rupture potential	S	---	---
Lower earthquake intensities	T	9.88	0.05%
Higher earthquake intensities	Z	---	---
Water	BLANK	3899.08	18.75%

EAGLE RIVER
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
SOIL EROSION POTENTIAL

Class	Symbol	Area - ha	Area - %
Very Low Soil Erosion	C	2918.44	14.04%
Low Soil Erosion	F	4982.84	23.97%
Moderate Soil Erosion	P	4291.83	20.64%
High Soil Erosion	T	1277.67	6.14%
Very High Soil Erosion	Z	1887.78	9.08%
Not Rated	X	1533.32	7.38%
Water	Blank	3897.84	18.75%

EAGLE RIVER
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
ECOLOGICAL SENSITIVITY

Class	Symbol	Area - ha	Area - %
Very Low Ecological Sensitivity	C	2628.82	12.64%
Low Ecological Sensitivity	F	5757.22	27.69%
Moderate Ecological Sensitivity	P	5786.86	27.84%
High Ecological Sensitivity	T	2052.67	9.87%
Very High Ecological Sensitivity	Z	666.31	3.21%
Water	Blank	3897.84	18.75%

EAGLE RIVER
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
WATER POLLUTION POTENTIAL

Class	Symbol	Area - ha	Area - %
Very Low Potential	C	8080.37	38.87%
Low Potential	F	5310.75	25.54%
Moderate Potential	P	1716.73	8.26%
High Potential	T	1517.88	7.30%
Very High Potential	Z	438.44	2.11%
Water	Blank	3725.55	17.92%

EAGLE RIVER
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
VISUAL QUALITY

Class	Symbol	Area - ha	Area - %
Very Low Visual Quality	C	3830.53	18.43%
Low Visual Quality	F	3368.00	16.20%
Moderate Visual Quality	P	7853.74	37.78%
High Visual Quality	T	3025.27	14.55%
Very High Visual Quality	Z	516.25	2.48%
Cultural Features	X	2195.93	10.56%

EAGLE RIVER
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
FIRE HAZARDS

Class	Symbol	Area - ha	Area - %
Very Low Hazard	C	120.42	0.58%
Low Hazard	F	2773.94	13.34%
Moderate Hazard	P	8781.88	42.24%
High Hazard	T	1722.90	8.29%
Very High Hazard	Z	1296.81	6.24%
Cultural Features	X	2195.93	10.56%
Water	Blank	3897.84	18.75%

EAGLE RIVER
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
RECREATION

Class	Symbol	Area - ha	Area -
High Capability/Suitability	Z	650.26	3.13%
Moderate Capability/Suitability	P	1385.73	6.66%
Low Capability/Suitability	F	7328.21	35.25%
Unsuitable	C	6580.39	31.65%
Park	A	947.29	4.56%
Water	Blank	3897.84	18.75%

EAGLE RIVER
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
CONSERVATION

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	5427.46	26.11%
Moderate Capability/Suitability	P	7213.97	34.70%
Low Capability/Suitability	F	482.91	2.32%
Unsuitable	C	3767.54	18.12%
Water	Blank	3897.84	18.75%

EAGLE
CAPAB SUITABILITY MAP LEGEND/STATISTICS
CONCERD URBANIZATION

Class	Symbol	Area - ha	Area - %
High Ca ity/Suitability	Z	---	---
Moderat ability/Suitability	P	---	---
Low Cap ty/Suitability	F	7961.80	38.30%
Unsuitab	C	5243.44	25.22%
Develope	A	3686.64	17.73%
Water	Blank	3897.84	18.75%

EAGLE RIVER
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
GENERAL DEVELOPMENT

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	208.10	1.00%
Moderate Capability/Suitability	P	3489.04	16.78%
Low Capability/Suitability	F	4667.90	22.45%
Unsuitable	C	4824.75	23.21%
Developed	A	3702.09	17.81%
Water	Blank	3897.84	18.75%

EAGLE RIVER
CONFLICT MAP LEGEND/STATISTICS
URBAN RESIDENTIAL/INDUSTRIAL

Class	Symbol	Area - ha	Area - %
Conflict Rating			
Level I (Substantial)	Z	54.96	0.26%
Level II	S	80.90	0.39%
Level III	P	200.70	0.97%
Level IV (Negligible)	F	1827.27	8.79%
Industrial	A	193.89	0.93%
Study Area	C	14534.16	69.91%
Water	Blank	3897.84	18.75%

EAGLE RIVER
CONFLICT MAP LEGEND/STATISTICS
RESIDENTIAL/COMMERCIAL

Class	Symbol	Area - ha	Area - %
Conflict Rating			
Level I (Substantial)	Z	122.27	0.59%
Level II	S	132.15	0.64%
Level III	P	213.66	1.03%
Level IV (Negligible)	F	1695.73	8.16%
Commercial	A	161.79	0.78%
Study Area	C	14566.28	70.05%
Water	Blank	3897.84	18.75%

EAGLE RIVER
POTENTIAL CONFLICT MAP LEGEND/STATISTICS
GENERAL DEVELOPMENT SUITABILITY/ECOLOGICALLY SENSITIVE LANDS

Class	Symbol	Area - ha	Area - %
Potential Conflict Rating			
Level I (Substantial)	Z	---	---
Level II	X	---	---
Level III	S	---	---
Level IV	P	15.44	0.07%
Level V	O	---	---
Level VI	M	1371.53	6.60%
Level VII	K	471.17	2.27%
Level VIII	F	303.82	1.46%
Level IX	D	4033.70	19.40%
Level X (Negligible)	C	6994.13	33.64%
Developed Land	A	3702.09	17.81%
Water	Blank	3897.84	18.75%

Anchorage Bowl
Map Legends and Statistics

Basic Data
Interpreted Data
Opportunity/Constraint Analyses
Capability/Suitability Analyses
Conflict Analyses

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
ELEVATION PROVINCE

Class	Symbol	Area - ha	Area - %
0 - 40m	C	13206.48	34.32%
40 - 100m	F	9302.46	24.18%
100 - 300m	P	4795.73	12.46%
> 300m	T	3303.16	8.59%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
LANDFORM (PRIMARY)

Class	Symbol	Area - ha	Area -
Bedrock	Z	305.68	0.79%
Colluvial Deposits	C	276.03	0.72%
Eolian Deposits	D	1279.52	3.33%
Fluvial Deposits	F	1129.46	2.94%
Glacial Deposits	K	4171.41	10.84%
Glaciofluvial/glacio-lacustrine Deposits	M	12499.41	32.48%
Lacustrine Deposits	P	310.62	0.81%
Marine Deposits	S	8380.49	21.78%
Organic Deposits	T	2255.21	5.86%
Man-made Landforms	X	----	---
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
VEGETATION (PRIMARY)

Class	Symbol	Area - ha	Area - %
Coniferous Forest	T	6350.67	16.50%
Mixed Forest	S	2058.22	5.35%
Deciduous Forest	P	15.44	0.04%
Black Spruce Forest	O	2649.82	6.89%
Wetland	Z	2712.19	7.05%
Shrub	M	2789.38	7.25%
Grassland	K	175.99	0.46%
Tundra	D	219.84	0.57%
Barren, Snow and Ice	A	2525.08	6.56%
Disturbed	X	11111.20	28.88%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
LAND USE

Class	Symbol	Area-ha	Area-%
Residential	O	7676.50	19.95%
Commercial/Institutional	P	4763.00	12.38%
Industrial	T	841.07	2.19%
Extractive	Z	349.52	0.91%
Transportation	S	1372.15	3.57%
Park	K	1551.23	4.03%
Agriculture	F	38.91	0.10%
Vacant Disturbed	C	870.72	2.26%
Non-developed	A	13144.73	34.16%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
SLOPE

Class	Symbol	Area - ha	Area - %
0 - 3%	C	18336.91	47.66%
3 - 7%	D	4799.44	12.47%
7 - 12%	K	2999.34	7.80%
12 - 20%	O	2237.92	5.82%
20 - 30%	P	726.21	1.89%
30 - 45%	T	548.37	1.42%
> 45%	Z	959.64	2.49%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
GEOLOGY

Class	Symbol	Area - ha	Area - %
Alluvium	C	10786.38	28.04%
Sand	F	2121.21	5.51%
Peat, Lake or Pond Sediments	M	4201.05	10.92%
Silt, Bootlegger Cove Clay	O	4178.20	10.86%
Glacial/morainal/marine deposits	P	5864.68	15.24%
Colluvium	K	2186.05	5.68%
Landslide Deposits	T	241.45	0.63%
Bedrock	Z	839.85	2.18%
Man-made Fill	X	188.96	0.49%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
BASIC DATA MAP LEGEND/STATISTICS
SOIL

Class	Symbol	Area - ha	Area - %
Sandy Loam	C	177.85	0.46%
Silt Loam	D	11919.55	30.98%
Gravelly/stony Silt Loam	K	1289.40	3.35%
Mucky Silt Loan	O	723.13	1.88%
Peat	P	2531.25	6.58%
Riverwash, Gravel Pits	S	411.27	1.07%
Rock Outcrops	Z	198.84	0.52%
Cryaquents/Cryorthents	X	3565.00	9.26%
Urban	A	9791.54	25.45%
Fire Island	A		
Water	Blank	7868.56	20.45%

ANCBOWL
INTD DATA MAP LEGEND/STATISTICS
WET

Cla	Symbol	Area - ha	Area - %
PatOpen Complex	D	1215.92	3.16%
Non-ned Elongated Complex	F	1577.17	4.10%
Lakeog	K	161.79	0.42%
Old Terrace Complex	M	---	---
Conc Closed Complex	O	---	---
Foreosed Basin Bog/swamp	P	430.42	1.12%
Non-ed Bog or Wet Meadow	T	61.75	0.16%
Largwater Marsh/Coastal Wetland	Z	3119.14	8.11%
Non-	A	24041.64	62.48%
Wate	Blank	7868.56	20.45%

ANCHORAGE BOWL
INTERPRETED DATA MAP LEGEND/STATISTICS
FLOODPLAINS

Class	Symbol	Area - ha	Area - %
No Flooding	A	26680.96	69.34%
100-yr. Floodplain	O	590.98	1.54%
Coastal Flooding	P	2655.99	6.90%
Coastal Flooding with Slow to Moderate Coastal Erosion	T	669.40	1.74%
Coastal Flooding with Rapid Coastal Erosion	Z	10.50	0.03%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL

INTERPRETED DATA MAP LEGEND/STATISTICS
HABITATS

Class	Symbol	Area - ha	Area - %
Fish	D	60.52	0.16%
Fowl	F	4160.91	10.82%
Moose	K	857.75	2.23%
Fish + Moose	P	---	---
Fowl + Moose	S	77.81	0.20%
Fish + Fowl + Moose	T	4.32	0.01%
No Habitat	A	25707.12	66.81%
Water	Blank	7607.96	19.77%

ANCHORAGE BOWL

INTERPRETED DATA MAP LEGEND/STATISTICS
SEPTIC SUITABILITY

Class	Symbol	Area - ha	Area - %
Severe limitations	T	13584.41	35.31%
Moderate limitations	K	2820.25	7.33%
Slight limitations	C	290.24	0.75%
Not rated	X	13912.93	36.16%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
INTERPRETED DATA MAP LEGEND/STATISTICS
SOIL DRAINAGE

Class	Symbol	Area - ha	Area - %
Very poorly drained	Z	2531.25	6.58%
Poorly drained	T	5212.56	13.55%
Somewhat poorly drained	P	324.82	0.84%
Moderately well drained	K	999.16	2.60%
Well drained	F	10292.98	26.75%
Somewhat excessively drained	D	651.49	1.69%
Excessively drained	C	770.06	2.00%
Not rated	X	9825.51	25.54%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
INTERPRETED DATA MAP LEGEND/STATISTICS
PERMAFROST

Class	Symbol	Area - ha	Area - %
Moderate Potential	K	23666.19	61.51%
High Potential	T	6941.64	18.04%
Unassessed Potential	C	---	---
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
INTERPRETED DATA MAP LEGEND/STATISTICS
AGRICULTURAL CAPABILITY (SOILS)

Class	Symbol	Area - ha	Area - %
Class II	C	2278.68	5.92%
Class III	D	1309.78	3.41%
Class IV	F	8999.25	23.39%
Class V	K	---	---
Class VI	P	219.84	0.57%
Class VII	S	3833.62	9.96%
Class VIII	Z	---	---
Not Rated	X	13966.66	36.30%
Water	BLANK	7868.56	20.45%

ANCHORAGE BOWL
INTERPRETED DATA MAP LEGEND/STATISTICS
SEISMIC HAZARDS

Class	Symbol	Area - ha	Area - %
Low-moderately low ground failure susceptibility			
Unknown surface rupture potential	C	3648.98	9.48%
Lower earthquake intensities	D	3728.64	9.69%
Higher earthquake intensities	F	10267.04	26.69%
Moderate ground failure susceptibility			
Unknown surface rupture potential	K	590.36	1.53%
Lower earthquake intensities	M	455.74	1.18%
Higher earthquake intensities	O	9763.13	25.38%
High-very high ground failure susceptibility			
Unknown surface rupture potential	S	80.90	0.21%
Lower earthquake intensities	T	---	---
Higher earthquake intensities	Z	2052.67	5.34%
Water	BLANK	7888.93	20.50%

ANCHORAGE BOWL
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
SOIL EROSION POTENTIAL

Class	Symbol	Area - ha	Area - %
Very Low Soil Erosion	C	4947.03	12.86%
Low Soil Erosion	F	5780.69	15.02%
Moderate Soil Erosion	P	2203.34	5.73%
High Soil Erosion	T	448.94	1.17%
Very High Soil Erosion	Z	894.80	2.32%
Not Rated	X	16333.03	42.45%
Water	Bland	7868.56	20.45%

ANCHORAGE BOWL
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
ECOLOGICAL SENSITIVITY

Class	Symbol	Area - ha	Area - %
Very Low Ecological Sensitivity	C	14327.91	37.24%
Low Ecological Sensitivity	F	10751.18	27.94%
Moderate Ecological Sensitivity	P	3565.62	9.27%
High Ecological Sensitivity	T	1661.15	4.32%
Very High Ecological Sensitivity	Z	301.97	0.78%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
WATER POLLUTION POTENTIAL

Class	Symbol	Area - ha	Area - %
Very Low Potential	C	19278.02	50.10%
Low Potential	F	4249.84	11.05%
Moderate Potential	P	3437.79	8.93%
High Potential	T	3083.94	8.02%
Very High Potential	Z	818.84	2.13%
Water	Blank	7607.96	19.77%

ANCHORAGE BOWL
OPPORTUNITY/CONSTRAINT MAP LEGEND/STATISTICS
FIRE HAZARDS

Class	Symbol	Area - ha	Area - %
Very Low Hazard	C	2525.08	6.56%
Low Hazard	F	5818.36	15.12%
Moderate Hazard	P	9932.95	25.82%
High Hazard	T	1045.48	2.72%
Very High Hazard	Z	174.76	0.45%
Cultural Features	X	11111.20	28.88%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
RECREATION

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	2407.75	6.26%
Moderate Capability/Suitability	P	3104.94	8.07%
Low Capability/Suitability	F	2378.72	6.18%
Unsuitable	C	21165.19	55.01%
Park	A	1551.23	4.03%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
CONSERVATION

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	4031.23	10.48%
Moderate Capability/Suitability	P	2948.70	7.66%
Low Capability/Suitability	F	6164.79	16.02%
Unsuitable	C	17463.11	45.39%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
CONCENTRATED URBANIZATION

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	---	---
Moderate Capability/Suitability	P	206.25	0.54%
Low Capability/Suitability	F	7596.23	19.74%
Unsuitable	C	6251.86	16.25%
Developed	A	16553.49	43.02%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
GENERAL DEVELOPMENT

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	1511.09	3.93%
Moderate Capability/Suitability	P	4517.23	11.74%
Low Capability/Suitability	F	1957.57	5.09%
Unsuitable	C	6029.55	15.67%
Developed	A	16592.39	43.12%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CAPABILITY/SUITABILITY MAP LEGEND/STATISTICS
ENERGY FACILITY SITING

Class	Symbol	Area - ha	Area - %
High Capability/Suitability	Z	---	---
Moderate Capability/Suitability	P	1029.42	2.68%
Low Capability/Suitability	F	1199.24	3.12%
Unsuitable	C	28379.17	73.75%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CONFLICT MAP LEGEND/STATISTICS
URBAN RESIDENTIAL/INDUSTRIAL

Class	Symbol	Area - ha	Area - %
Conflict Rating			
Level I (Substantial)	Z	626.79	1.63%
Level II	S	647.17	1.68%
Level III	P	1081.91	2.81%
Level IV (Negligible)	F	5320.63	13.83%
Industrial	A	2232.98	5.80%
Study Area	C	20698.35	53.80%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
CONFLICT MAP LEGEND/STATISTICS
RESIDENTIAL/COMMERCIAL

Class	Symbol	Area - ha	Area - %
Conflict Rating			
Level I (Substantial)	Z	1114.64	2.90%
Level II	S	1198.62	3.12%
Level III	P	1708.70	4.44%
Level IV (Negligible)	F	3654.54	9.50%
Commercial	A	4763.00	12.38%
Study Area	C	18168.33	47.21%
Water	Blank	7868.56	20.45%

ANCHORAGE BOWL
POTENTIAL CONFLICT MAP LEGEND/STATISTICS
GENERAL DEVELOPMENT SUITABILITY/ECOLOGICALLY SENSITIVE LANDS

Class	Symbol	Area - ha	Area - %
Potential Conflict Rating			
Level I (Substantial)	Z	---	---
Level II	X	4.32	0.01%
Level III	S	---	---
Level IV	P	59.28	0.15%
Level V	O	---	---
Level VI	M	1065.86	2.77%
Level VII	K	876.89	2.28%
Level VIII	F	35.20	0.09%
Level IX	D	3190.77	8.29%
Level X (Negligible)	C	8783.12	22.83%
Developed Land	A	16592.39	43.13%
Water	Blank	7868.56	20.45%

BIBLIOGRAPHY

ANCHORAGE ITUM
COLLATERAL DATA

ANCHORAGE BOWL (INCLUDING FIRE ISLAND)

Series: Geotechnical Hazards Assessment & District Coastal Management Program

101 Geotechnical Hazards Assessment: Groundwater, Icings, and Permafrost
Mylar 1:25,000
Municipality of Anchorage 3-79
Comments: Reference only
Plate 5A

102 Geotechnical Hazards Assessment: Seismically Induced Ground Failure
Mylar 1:25,000
Municipality of Anchorage 3-79
Comments: Plate 2A

103 Geotechnical Hazards Assessment: Tectonic Hazards and Maximum Expectable Earthquake Intensities
Mylar 1:25,000
Municipality of Anchorage 3-79
Comments: Plate 1A

104 Geotechnical Hazards Assessment: Mass Wasting
Mylar 1:25,000
Municipality of Anchorage 3-79
Comments: Plate 3A

105 100-Year Floodplain and Inland Extent of Coastal Flooding
Mylar 1:25,000
Municipality of Anchorage, District Coastal Management Program (DCMP) 12-77

106 Coastal Habitats
Mylar 1:25,000
Municipality of Anchorage, DCMP 12-77

107 Geotechnical Hazards Assessment: Coastal Erosion, Flooding and Wind
Mylar 1:25,000
Municipality of Anchorage 3-79
Comments: Plate 4A

108 Soils
Mylar 1:25,000
Municipality of Anchorage

109 Lakes and Streams
Mylar 1:25,000
Municipality of Anchorage DCMP 12-77

110 (Base Map)
Mylar 1:25,000 (1m x 1.1m)
Municipality of Anchorage DCMP 12-77

111 (Colored map, incomplete)
Mylar 1:25,000
Municipality of Anchorage DCMP 12-77

112 Slope Stability
Mylar 1:25,000
Municipality of Anchorage DCMP 12-77
Comments: Slope Stability, Area of Potential Large Landslides, Earthquake Depos

113 Foundation Conditions
Mylar 1:25,000
Municipality of Anchorage DCMP 12-77

General

114 Fire Island Base Map
Mylar, Scale Unknown (~1:12,000?)
Source Unknown

115 South Anchorage Area, Soils
Delineations on Photo, Scale Unknown
Source Unknown
Comments: Supplementary interpretations for area south and east of DCMP

116 Geology (?) - Unlabeled Delineations
Blueline, Scale Unknown (~1:62,500?)
Source Unknown

117 Soil Interpretations - Residential Suitability
Blueline with Crayon, 1:25,000
Municipality of Anchorage, DCMP, 12-77
Comments: DCMP soils map colored according to SCS interpretations for dwellings with basements and dwellings without basements

118 Parcel Map, Portion of Anchorage
Mylar, Scale Unknown
Source Unknown

119 Land Ownership and Zoning
Paper (printed color), 1:25,000
Municipality of Anchorage, 80
Comments: Exact study area boundaries.

120 Wetlands
Blackline, 1:25,000
Municipality of Anchorage 8-80
Comments: Wetland type and number referring to "Municipality of Anchorage Wetland Study: Classification of Wetlands: 8-80

121 Anchorage Coastal Resource Atlas
Bound Paper Color Maps 1:25,000
Municipality of Anchorage/Stuart Allen 1980
Comments: Atlas of maps for Anchorage Bowl area of:
a. Land Use
b. Wildlife Habitats
c. Surficial Geology
d. Seismically-Induced Ground Failure
e. Land Ownership and Zoning
f. Floodplains and Wetlands
g. Mass Wasting
h. Foundation and Excavation Conditions
i. Slope and Wind
j. Coastal Management Zone: Preservation
k. Coastal Management Zone: Conservation and Utilization

122 Base Maps - USGS 7.5' Quads
Paper 1:25,000
USGS - Municipality of Anchorage
Comments: Anchorage (A-8) SW, NW, SE, NE; Tyonek (A-1) NW, NE. No Tyonek (A-1) 1:25,000 SW, SE coverage available

123 Natural Color Aerial Photographs
Prints, 1" = 1000'
Municipality of Anchorage 9-80
Comments: Two boxes containing Flights 1 - 5 and 6 - 11.

124 Water-Table Contour Map, Anchorage Area, Alaska
Printed Paper 1:24,000
USGS/Greater Anchorage Area Borough (Open File Report, 1974)
Comments: 20' contour interval, 1962 base map

125 Relative Permeability of Surficial Geologic Materials
Printed Paper 1:24,000
USGS/Municipality of Anchorage, 1976
Comments: No Coverage for Fire Island.

126 Generalized Geologic Map
Printed Paper 1:24,000
USGS, 1972
Comments: Modified, simplified from standard geology sheets

127 Foundation and Excavation Conditions
Blueline 1:24,000
USGS, 1973 (Open File)
Comments: Closely related to generalized geology map

128 Slope Map
Blueline 1:24,000
USGS, 1972 (Open File)
Comments: 6 categories (< 5, 15, 25, 45, 100, 100+) plus hummocky, graded, escarpments

129 Slope-Stability Map
Blueline 1:24,000
USGS, 1973
Comments: 126-129 in series of USGS "Anchorage and Vicinity" maps

EAGLE RIVER

Series: Geotechnical Hazards Assessment & District Coastal Management Program

203 Soils
Mylar 1:25,000
Municipality of Anchorage DCMP 12-77

204 (Base Map)
Mylar 1:25,000
Municipality of Anchorage DCMP 12-77

205 Drainage Conditions of Surfaced Materials
Mylar/Color 1:25,000
Municipality of Anchorage DCMP 12-77
Comments: Legend Incomplete

206 Geotechnical Hazards Assessment: Tectonic Hazards and Maximum Expectable Earthquake Intensities
Blueline 1:25,000
Municipality of Anchorage 3-79
Comments: Earthquake Intensity Zones, Tectonic Subsidence Plate 1B

207 Geotechnical Hazards Assessment: Seismically Induced Ground Failure
Blueline 1:25,000
Municipality of Anchorage 3-79
Comments: Plate 2B

208 Geotechnical Hazards Assessment: Coastal Erosion, Flooding, and Wind
Blueline 1:25,000
Municipality of Anchorage 3-79
Comments: Plate 4B

209 Geotechnical Hazards Assessment: Groundwater, Icings, and Permafrost
Blueline 1:25,000
Municipality of Anchorage 3-79
Comments: Groundwater, Frozen Ground, Icings
Plate 5B

210 100-Year Floodplain and Inland Extent of Coastal Flooding
Blueline 1:25,000
Municipality of Anchorage DCMP 12-77

211 Geotechnical Hazards Assessment: Mass Wasting
Blueline 1:25,000
Municipality of Anchorage 3-79

212 Geology
Mylar/Color 1:25,000
Municipality of Anchorage DCMP 12-77

213 Wetlands
Blueline 1:25,000
Municipality of Anchorage 8-80
Comments: Wetland type + no. referring to "Municipality of Anchorage Wetland Study: Classification of Wetlands" 8-80.

General

201 Soils - Suitability for Dwellings
Blueline with Crayon, 1:25,000
Source Unknown
Comments: Map of soils colored according to interpretations for suitability for dwellings

202 Soils
a. Mylar 1:25,000; b. Blueline
Unknown (same as previous listing)
Comments: Larger Coverage than DCMP Maps

214 Base Maps - USGS 7.5' Quads
Acetate 1:25,000
Comments: Anchorage (B-7) SW, NW, SE, NE Quads

215 Parcel Map
Acetate 1:25,000
Municipality of Anchorage

216 Natural Color Aerial Photographs
Prints, 1" = 1000'
Municipality of Anchorage
Comments: Two boxes containing Flights 1 - 7 with 7a + 6a and 8 - 13 with 8a + 1 oblique

217 Geology
Blueline 1:25,000, Photocopied legend sheets
Municipality of Anchorage, 81

218 Habitats
Blueline 1:25,000 (?)
Municipality of Anchorage, n.d.
Comments: Hand-drawn areas; delineations of moose, fish, bird habitats

GENERAL

303 CIR Photo Transparencies - 2 Packages
a. 28 Transparencies + 1 Print
b. 7 Transparencies

304 Eagle River-Chugiak-Eklutna Comprehensive Plan
Printed Volume
Municipality of Anchorage 9-79
Comments: Includes page-size maps

305 Geology and Ground Water for Land-Use Planning in the Eagle River-Chugiak Area, Alaska - 1974
Printed volume plus 2 blueline plates (type of aquifer, depth to bedrock and yield; well depth and depth to water) at 1:63,360 plus printed plate (water well and spring location map) at 1:25,000
U.S. Department of the Interior, USGS, in cooperation with Greater Anchorage Area Borough (Open-File Report 74-57)
Comments: Includes small-scale maps of foundation conditions, slope stability

306 Hydrology for Land-Use Planning, the Hillside Area, Anchorage, Alaska
Printed Volume
USGS/Greater Anchorage Area Borough (Open-File Report 75-105)

307 Geotechnical Hazards Assessment Study
Published Report
Municipality of Anchorage (Harding-Lawson Assoc.), 6-79 (Ret. to T. Burns)
Comments: Geology, Seismicity, Seismic Hazards (tectonic, ground failure), Non-seismic Hazards (mass wasting, erosion, tsunami, wind, groundwater, permafrost), Guidelines for Planning

308 Anchorage Area Soil Survey, Volume 7
Published Report
USACE, 1979
Comments: Metropolitan Anchorage Urban Study

309 Soil Survey, South Anchorage Area Alaska
Published Report
USDA-SCS, 11-80
Comments: No maps; adjoins Anchorage Survey on west and north, Chugach SP on south and east

310 Soils of the Anchorage Area, Alaska, Part X
Photocopied Report
USDA-SCS for USACE, 4-77

311 Municipality of Anchorage Wetlands Study: Mapping and Classification of Freshwater Wetlands
Photocopied Report
Municipality of Anchorage (by Fugro Northwest), 9-80
Comments: Contains classification for each mapped wetland on Anchorage Bowl, Eagle Riversheets

312 Municipality of Anchorage Wetlands Study: Resource Analysis
Photocopied Report
Municipality of Anchorage (by Fugro Northwest), 2-81
Comments: Sets forth criteria for mapping and classification

313 Coastal Management Planning in Anchorage, Alaska
Photocopied Report
Municipality of Anchorage (Anthony Burns), n.d.
Comments: Contains matrix for environmental assessment

314 Water Resources of the Cook Inlet Basin, Alaska
Printed Paper, 1:1,000,000 4 Sheets
USGS/DNR 1980
Comments: Maps with text, charts, profiles, etc.
Sheet 1 - Geology (maps of Generalized Geology, Quaternary Sediment Thickness)
Sheet 2 - Groundwater (map of Generalized Ground-Water Availability)
Sheet 3 - Surface Water (map of Mean Annual Runoff)
Sheet 4 - Surface Water (map of Minimum Discharge, $M_{7,10}$ (7 day minimum discharge with a 10-yr. recurrence interval))

315 Generalized Geologic Map of Anchorage and Vicinity
USGS, 1972. Map I-787-A
Comments: Landforms for Anchorage Bowl.

316 Preliminary Geologic Map of the Middle Part of the Eagle River Valley, Municipality of Anchorage, Alaska.
USGS Open File Report No. 80-890, 1980
Comments: Landforms for Eagle River

317 Geology and Groundwater for Land Use Planning in the Eagle River Area, Alaska
USGS Open File Report No. 74-57, 1974
Comments: Landforms for Eagle River.